JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the act of Congress March 3, 1879.

VOL. XXXVI NO. 17 | SAN FRANCISCO, APRIL 22, 1916 | PER COPY, 25 CENTS

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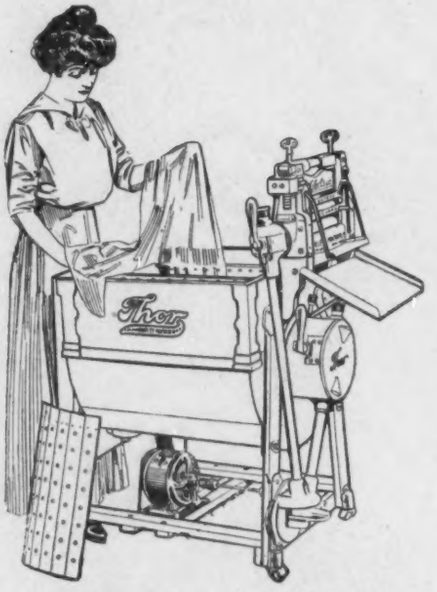

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JOURNAL OF ELECTRICITY
POWER AND GAS
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VOLUME XXXVI SAN FRANCISCO, APRIL 22, 1916 NUMBER 17

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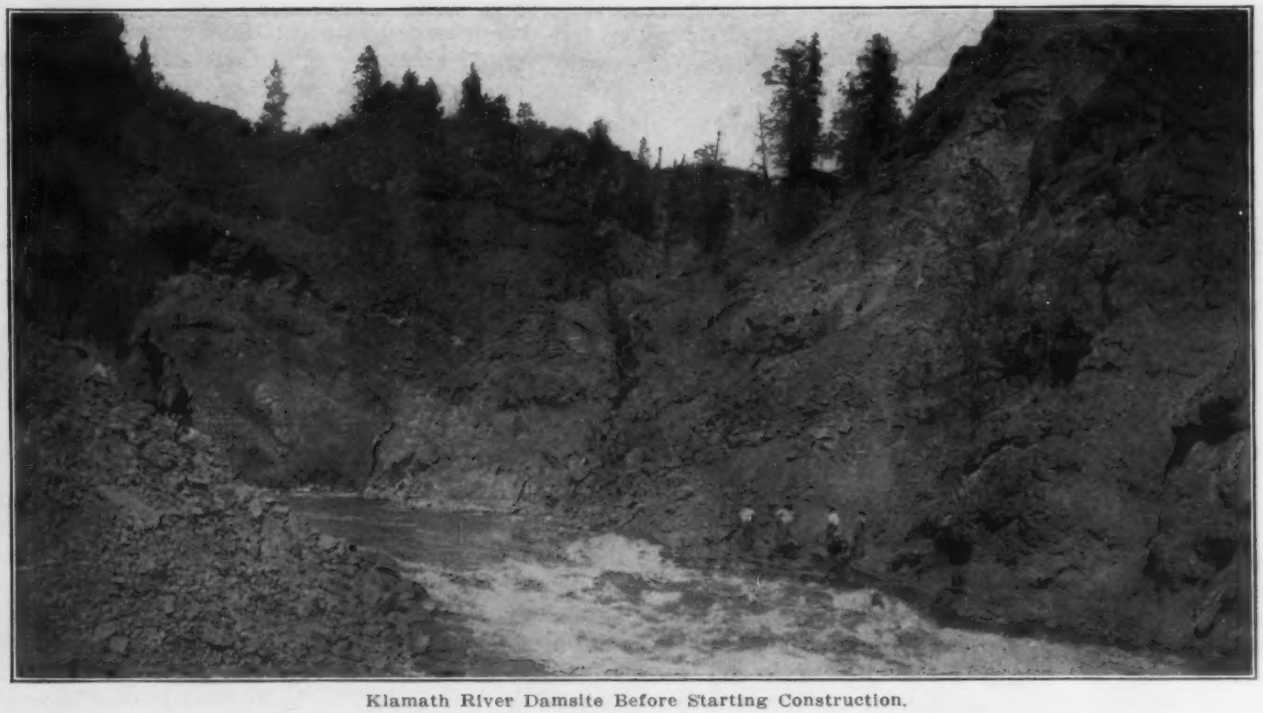
GROUTING FOR THE KLAMATH RIVER DAM

BY SIDNEY SPROUT.

Some unusual conditions encountered in the construction of the Klamath River Dam, now being built by the California-Oregon Power Company, makes a record of interest. After one site had been selected it was found that one of the side walls contained loose rock which would be liable not to hold and so another site was selected as shown in the accompanying illustration. This site showed good walls and apparently good foundations and so a wing dam was built to divert the river from its channel into a tunnel on the east side of the river, thus making possible construction operations without interference from the river flow.



Klamath River Damsite Before Starting Construction.

The dam is to be of the arch-gravity type designed on the Wegmann principle. It was designed for a height of 130 ft. above the bottom of the river, 90 ft. thick at the base and 13 ft. thick at the top. The base as laid out on the ground, since starting foundation, has been widened to 95 ft. at the assumed bottom. The length of the crest will be 400 ft. curved on the arc of a circle of 356 ft. radius, curvature upstream. The center 200 ft. of the crest will be an overflow section, capable of discharging the highest flood water.

Owing to the position of the highest bed rock of the canyon wall at the dam site, it was found impossible to place the dam diagonally across the river bed. This, however, does not affect the strength of the structure. The total yardage of the dam above foundations will be about 35,000 cu. yd., of which 40 per cent to 50 per cent will be hand laid rock. Railroad rails will be used as reinforcing throughout the dam.

Diamond Drilling.

Diamond drill borings were made below the level of the river to determine the character of the river bottom. At first these drillings were not considered as giving the true condition of the river bottom. It was fully believed that bed rock would be found not to exceed a depth of 25 ft. below water level. A bed rock was subsequently found at this depth but was a slab about 4.5 ft. thick. The drillings showed a seam

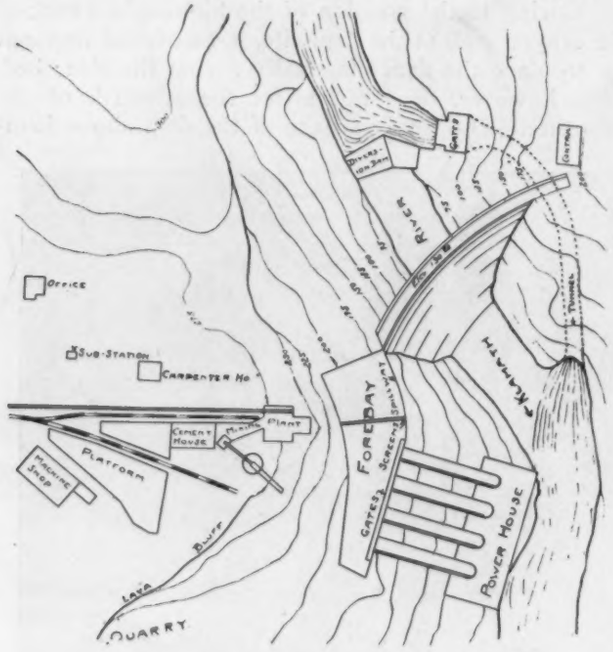
or opening in the river channel running 140 ft. below water level and averaging about 30 ft. wide. This seam was found later in excavating to follow very closely the diamond drill borings.

Total cost of drilling	$4006.42
Total number of feet of holes drilled	2400
Cost per foot of hole	$1.67

Grouting Through the Diamond Drill Holes.

In view of the fact that the diamond drill holes which were run in the bottom of the river indicated that the seam in the river bottom was filled with gravel and sand, it was decided to try injecting cement grout through the holes to see if concrete could be made of sufficient stability to keep the gravel in place.

By the means of a cement gun it was hoped to force the cement through a pipe line to the bottom of the diamond drill hole and thence through a special nozzle into the gravel and sand. Air was allowed to run through the pipe all the time to keep the water from coming up from the bottom of the hole into the



Map of Klamath River Damsite.

pipe. The first difficulty experienced when the dry cement was allowed to run in with the air, was that the air was too moist and the cement gradually collected on the sides of the discharge pipe until it was clogged. The air line was then heated to dry the air and better results were obtained. The moisture still bothered to some extent and the process was so slow that it was decided to try grout instead of dry cement.

For grouting, a small self-contained 2 in. centrifugal pump and motor was used. A pipe line connected with the diamond drill hole was used as the discharge for the pump, this line being placed far enough into the hole so that it could be calked around the collar of the hole. The suction for the pump was placed in a barrel in which a hose discharged a continuous stream of water, and into which cement was poured continuously and thoroughly stirred. When the pump was started the cement and water was fed into the barrel until no more could be forced through the diamond drill hole, then a stop cock was shut off at the collar of the hole and the discharge pipe disconnected at the surface of the ground. Clear water was then pumped through the suction hose and pump until all the cement was cleaned out of them. After disconnecting the remainder of the discharge hose and allowing the cement to set for a while the pipe was pulled from the hole and connected to another.

The grouting was first started by connecting with hole No. 17 in which 28 sacks of cement were injected and as far as can be determined the mixture around the lower end of the hole is firmly grouted and concreted together. Hole No. 2 on the same side of the river was then connected up and 69 sacks of cement were injected through it. Some of the cement was observed to come to the surface near the east bank of the river. Very little water came back out of either hole.

The grouting equipment was then moved to the west side of the river and connected with hole No. 15, 37 sacks of cement being injected through it; 30 sacks were injected through hole No. 16; and 23 sacks were injected through hole No. 19. By grouting in these holes all the longitudinal seams between shafts No. 1 and No. 2 were cemented up and the shafts became nearly dry.

It was intended to place the diamond drill over these grouted holes and drill them out again to determine the extent of the grouting, but owing to temporary shut down of the work, it was impossible to continue. When work was resumed and sinking started, in the river bottom a better form of grouting was found.

Dam Foundation.

In constructing the dam foundation it was decided to provide two curtain walls of grouted material to the full depth, one on the upstream face and one on the downstream face. After this were completed the intervening material was excavated and replaced by concrete.

Work was started on the upstream face first. A crib work was constructed, made up of three cribs, one on each side of the river and a large one spanning the main river channel between them. The cribs on the two sides of the river were afterwards divided into smaller compartments making five cribs in all. Excavation was then started on the east side of the river. The intention was at first to excavate all of the crib but it was found that the rock and gravel on the outer face of the crib leaked so badly that it was impossible to go very deep. A 12 in. pump was installed and bed rock cleaned out to within 4 ft. of the edge. Concrete was then poured to 10 ft. above water level in this crib. In the meantime excavation was started on the west side of the river, carried to bed rock out as far as river edge and filled with concrete to 10 ft. above water level. This made two blocks of concrete, one on the east side of the river and one on the west side of the river, both standing on the river edge and about 90 ft. of river channel between them.

Excavation was then started on the west side of the river adjoining the block of concrete. The plan at first was to carry shafts across the river which would

be 20 ft. wide in the direction of the flow of the river. The first compartment taken was 20 by 30 ft. and excavation was started in it. After a few feet of sinking it was found that it would be impossible to handle the water in this size compartment so it was cut in two compartments 20 by 15 ft. The upstream compartment of these two was excavated first and after considerable pump trouble bed rock was found at a depth of 13 ft. The downstream compartment was then finished (10 by 15 ft.) and both compartments filled to water level with concrete.

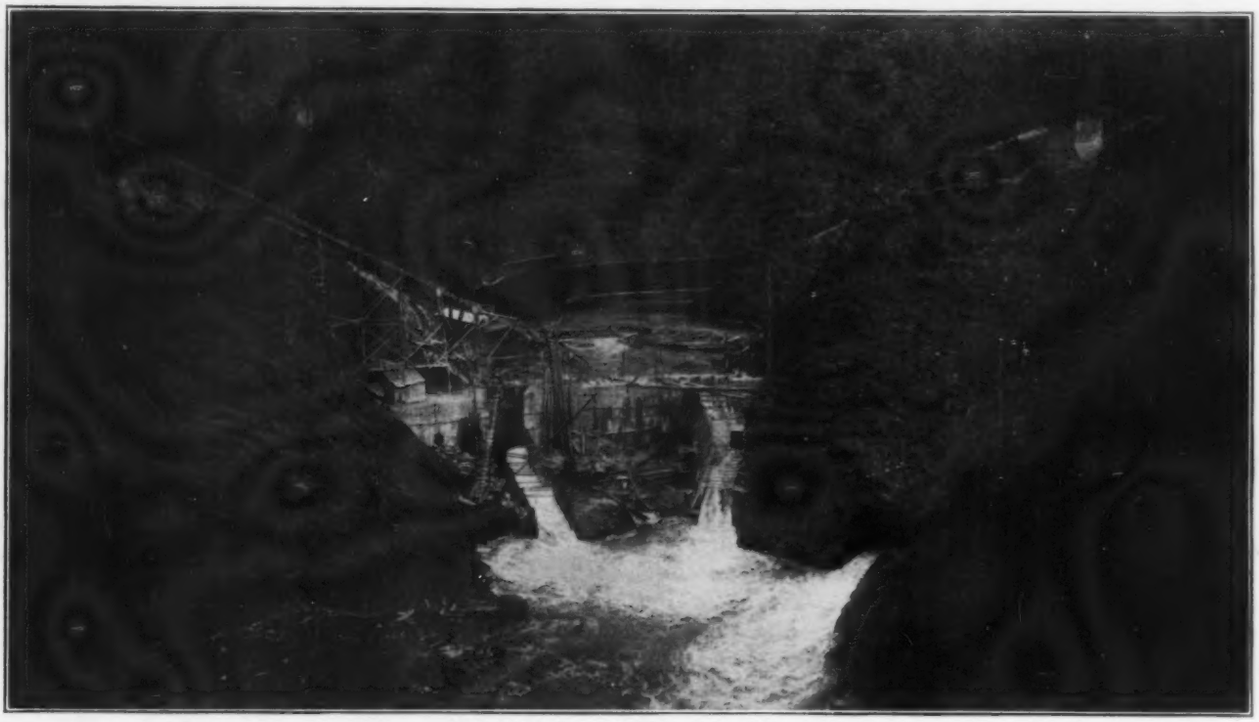
A spillway, 11 ft. wide, was left through the concrete on water level and just a wall of concrete was carried up on the east side of this spillway. The spillway was connected on the lower side with a 4 by 12 ft. flume 70 ft. long which discharged below the lower toe of the dam and the water which leaked through the wing dam was diverted through it. This left the remainder of the river channel open for excavation.

The river was beginning to raise so a large flume was built in conjunction with the small one and extended from the spillway of the wing dam, across the block of concrete on the east side of the river to about 20 ft. below the downstream toe of the dam. This flume was large enough to hold 3000 second feet.

Having encountered considerable trouble with water up to this time, an attempt was made to grout around the next shaft adjoining the concrete on the west side of the river. This shaft was 10 by 22 ft. A single line of grout pipes was driven around the shaft, spaced 2 ft. centers and driven as deep as possible, some of them penetrating as deep as 26 to 29 ft. After grout was injected through all the pipes and allowed to set for 3 or 4 days, sinking was resumed. It was found that the grouting was not entirely successful. Some of the water was shut off but not enough to make sinking easy.

The plans were then changed and instead of trying to carry a 20 ft. wall across the river it was cut into two 10 ft. walls. The 10 ft. wall on the upper face of the dam was laid off and the first shaft on the west side of the river was started.

Considerable trouble was again found in holding the water so that the men could work but this shaft was sunk under adverse conditions to apparent bed rock at 26 ft. below water level. This shaft was filled with concrete to water level and the next shaft, adjoining it on the east side started. This shaft, known as the northwest compartment of crib No. 3, was the most difficult shaft to sink of any on the wall. As stated above, the grouting was not entirely successful up to this time and the pumps would not handle the water. The material found in the shaft down to 12 ft. below water level was loose rock and below that it was very fine sand, resembling quicksand. Lagging could not be driven close enough to hold the sand with the water running over it. When the sinking had been carried down to 16.5 ft. below water level, work had to be stopped on account of the water and some other method used for holding the water from running into the shaft over the sand.



View of Foundation Construction.

At this time (Jan. 1, 1914), the river took a sudden raise and overflowed its waste ways, causing considerable delay in the shaft work. On resuming work a pile driver was set up and Wakefield tongue and groove sheet piling driven through the sand in the shaft reaching apparent bed rock at about the same depth as in the preceding shaft (26 ft.) This shaft was then filled with concrete to water level.

In the meantime a successful method of grouting, as later described, was found and the remainder of the

shafts of this wall were sunk without very much trouble.

When the last shaft was sunk near the east wall it was found that at the depth of 26 ft. there was no bed rock and that the preceding blocks of concrete beginning on the west side spillway were not on bed rock, but on a false bed rock at 26 ft. depth. The sinking was stopped at this depth and the shaft filled with concrete in order to protect the finished work from high water.

All of this upstream wall 10 ft. thick was then carried 10 ft. above water level and sinking was started on the downstream half of it, beginning on the west side. Successful grouting made it possible to work on this downstream half of the wall without much trouble from water.

The bed rock wall on the west side was found to drop off about 40 ft. vertically after passing the false bed rock of the upper half of the wall. At 70 ft. below water level, bed rock was found and concrete was poured up to within 35 ft. of water level. A sump was built at this level and water leaking into the shaft was caught up and pumped to the surface.

Two more shafts were sunk to the same depth and joined this one on its east side. Instead of filling with concrete it was decided to finish the excavation of this part of the wall and fill it all at once. When the last shaft was sunk on the east bed rock wall, no bed rock was found at 70 ft. below water level. Sinking was carried on down to 116 ft. below water level before bed rock was found. The east wall was found to follow very closely the diamond drill borings.

The four shafts sunk to bed rock at 70 ft. below water level were then found to be sunk only to a projecting shelf of bed rock joining on the west wall and extending across the river to within 10 ft. of the east wall. As these shafts had not yet been filled, one of them was continued through the shelf of bed rock and all the loose material beneath was removed and the hole filled with concrete. The maximum depth was found in the middle of the channel, 126 ft. below water level.

Bed rock in the bottom of the wall was found to pitch from the lower side of the shafts to about 10 ft. deeper on the upper edge of the shafts. It was somewhat irregular from the effects of erosion but at no place in the bottom was there an indication of a seam. It was expected that when the bottom was reached that a seam would be found continuing deeper, but this was not the case.

Concrete was then poured in all the remaining shafts and carried above water level to the top of the 10 ft. wall and on up so all of the wall was completed to 30 ft. above water level.

The question arose during the filling as to whether or not the material under the false bed rock should be removed. This bed rock, as noted above, was 26 ft. below water level, about 4.5 ft. thick and lay under the upstream half of the wall across the river channel. As the question was undecided, a shaft was left in the downstream half of the wall to a depth of 56 ft. below water level. This shaft is in such a position that the material under the false bed rock can be excavated from it should it be necessary.

The spillway was left through the west side concrete as noted before and an auxiliary spillway was made above it. When the concrete work reached the flume on the east side of the river, the flume was cut and a spillway left through the concrete joining with the downstream half of the flume. This gave spillway capacity sufficient to carry all of the flood water of 1914 and the spring of 1915.

This completed the upstream wall to 30 ft. above water level, which was the same height as the old wing dam and at the same time placed 1/7 of the total yardage of the original proposed dam. The upstream side of this wall was surfaced with cement grout sprayed on with an air cement gun.

During January, 1915, work was started on the lower tow of the dam. Crib work had already been placed across the river and preparations made for sinking a concrete cut-off wall which would shut off any back water from downstream. The wall was laid out on the curve of the downstream toe of the dam, extending 8 ft. thick in the direction of the flow of the river and to be excavated vertically instead of following the slope of the dam.

It was first necessary to do considerable grouting before sinking. Details of this work is shown under grouting.

A shaft was started on the west side of the river, 8 by 16 ft. extending along the proposed wall. This was sunk without difficulty to bed rock. The deepest place in the shaft was 15 ft. below water level, near its east end. Concrete was then poured in the shaft to water level and the small flume on the west side of the river was rebuilt and placed on top of this concrete. The remainder of the wall was then left open and grouting continued across the river on the downstream side of the wall. The width of the wall from the west block of concrete to the east side bed rock was 60 ft.

A shaft was then started on the west side of the river and at the date of this report has been sunk to 75 ft. below water level. The bed rock on the west side was found to follow very closely the diamond drill borings and drops nearly vertically in the full depth sunk at present.

The character of material found in this lower work is very much different from that of the upper wall. In the upper wall after sinking 15 to 25 ft. through loose rock, the material was entirely fine sand and gravel. In the lower wall the material found so far is large washed boulders with some gravel and sand between them. This makes blasting necessary and consequently the work progresses much slower.

Grouting in the River Bottom.

In general, the grouting on the upper wall was carried across the river one shaft at a time, that is, for each shaft sunk, a row of grout pipes was driven around it. When sinking was first started it was found that the upper part of the river bed from 10 to 15 ft. deep was filled with loose rock and gravel with sufficient voids in it to readily admit the water from both upstream and downstream sides. In a shaft 8 by 16 ft. it was found that a 12 in. pump would hardly handle the water which came in through the sides.

It was practically impossible to sink to any depth with such a quantity of water.

Some means had to be employed to stop the water. Piling could not be driven on account of the rocks and boulders, pneumatic sinking and freezing were too expensive so it was decided to try grouting up the material by filling the voids of the material.

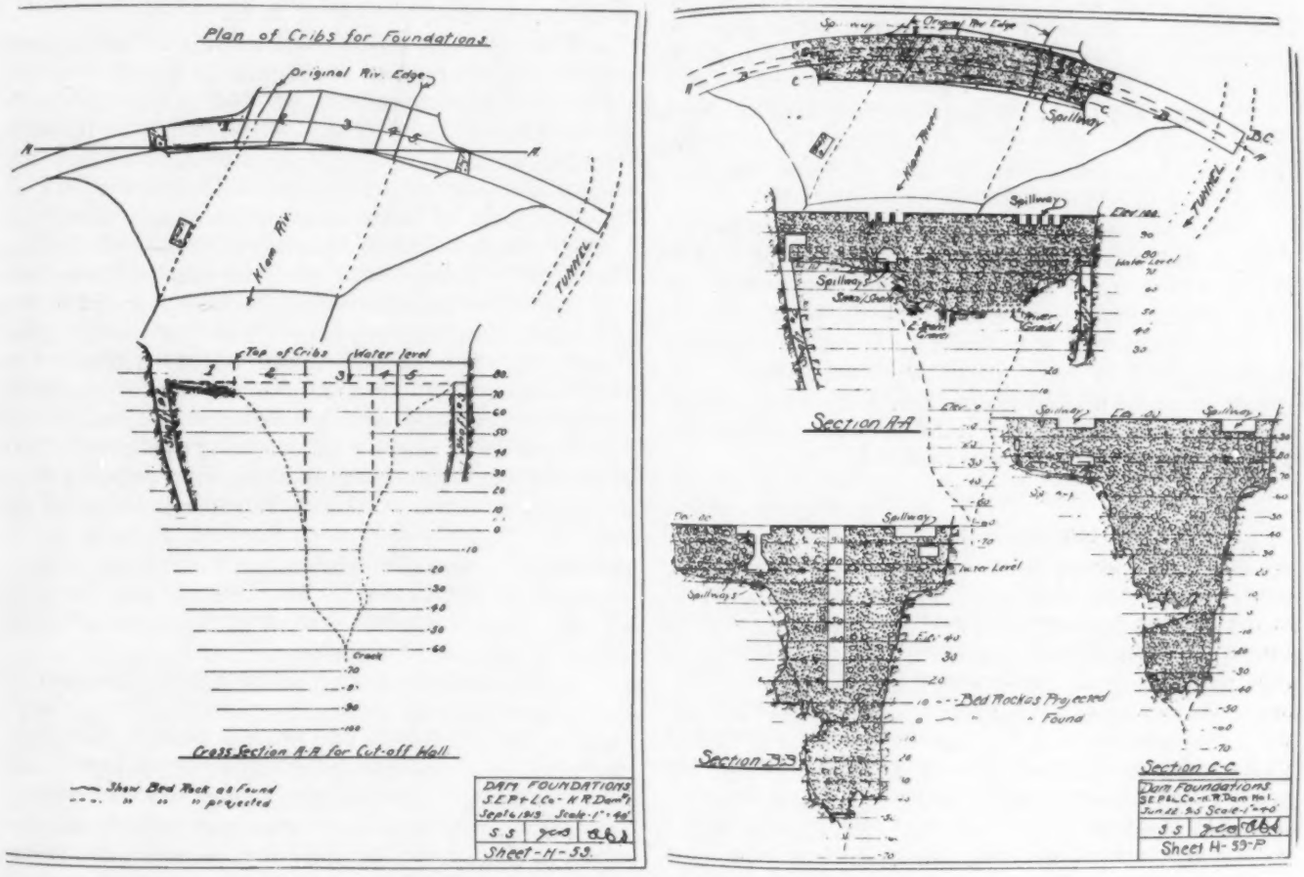
At first the grouting was an experiment. A row of 2 in. pipes was driven around the first shaft on the west side of the river. A barrel set on a platform 60 ft. above the top of the pipes was connected with a 2 in. hose and pipe line to each grout pipe in turn and the cement and sand run through the pipe as they were slowly raised. Some of the holes took as much as 150 sacks of sand and cement but when excavation was started it was found that the grouting did not shut off very much of the water. The high pressure of 60 ft. was too much and caused the grout to spread too far away from the hole to raise the surface of the ground.

After some experimenting a satisfactory method of grouting was found as follows:

An air drill was set up on staging vertically above where the row of holes was to be driven. The drill bits were made to pass through a 2 in. black iron pipe and changes were made just the same as in drilling a hole for blasting. At first the drills were made in 2 ft. changes up to 30 ft. in length but it was found that below 15 ft. the material of the river bottom would take no grout, so the length of the drill was cut down to 16 ft.

Sections of 2 in. pipe were cut to correspond to the drill changes and so that they would leave the drill exposed 3 in. below the lower end of the pipe when the pipe was up against the chuck. When the drill and pipe were in place the machine was started and the pipe was driven with the chuck of the machine at the same time that the drill was making the hole. When the drill was pulled out, the pipe was left in place. A row of these pipes were driven, spaced 2 ft. centers and from 11 to 14 ft. in depth, around the shaft to be excavated.

Whenever a rock was struck the drilling was continued to a reasonable depth, without driving the pipe. The drill was removed and a small charge of powder set off in the hole to break up the rock.



"Before and After" Views of Dam Foundation.

This row of pipes was then ready to receive the grout.

A 50 gallon barrel was set up on a frame 30 ft. above the top of the pipes. From the bottom of it, a 2 in. pipe extended down and was connected by a short hose with the first grout pipe. At the bottom of the barrel was a 2 in. valve for shutting off the main line, as it was called, and below the valve was a pipe connected with a valve for letting water into the main line under pressure. At the connection on top of the grout pipe there were also two valves for shutting off the main line from the grout pipe and for letting the main line discharge its charge from the side of the pipe.

Cement and sand were dumped into the barrel while water was running into it and stirred constantly

with a pipe stirring rod through which air was passing under pressure.

The grout pipe was then pulled 3 or 4 in. and both main line valves opened. The grout passed from the barrel through the line and grout pipe into the open spaces of the material in the river bed. When the grout began to pass slowly the grout pipe was pulled a few inches and again left standing as long as grout would pass through it. By pulling the grout pipe a few inches at a time, as much as 30 sacks of cement and sand could be forced into a hole and grout could be forced into the material as close as 3 ft. to the surface. Every pipe was treated in the same way and after they were pulled out and were again used for the next row of holes.

After three days setting for the grout in the first row of pipe a second row was driven. The pipes in the second row were staggered with those of the first and the rows were only 2 ft. apart.

The second row of holes would not take as much grout as the first but from the table it will be seen that there still remained considerable voids in the material close to the first row of holes.

After the second grouting was allowed to set for 7 days, sinking was started and it was found that in shafts where a 12 in. pump would not handle the water a 4 in. pump would easily handle it.

The grout wall was found to stand well without timbering and in some places was 10 ft. thick. The grout spread on an average of three feet on each side of the grout pipe and proved to be very satisfactory filling for the voids in the river material.

A portable telephone, made of aluminum and weighing 2½ pounds, the invention of a forest officer, R. B. Adams of Missoula, Montana, will be part of the regular equipment of patrolmen on the National Forests the coming field season. This instrument is regarded as a great improvement over the set formerly used, which weighed ten pounds. A field man equipped with this telephone, a few yards of light emergency wire, and a short piece of heavy wire to make the ground connection can cut in anywhere along the more than 20,000 miles of Forest Service telephone lines and get in touch with the headquarters of a supervisor or district ranger. To talk, one end of the emergency wire is thrown over the telephone line, the two ends are connected to the portable instrument, and the instrument is connected to the ground wire, the end of which must be thrust into the damp earth or in water. Contact with the line wire is made possible by removal of the insulation from a few inches of the emergency wire.

The Adams instrument does not ring the bell of the receiving telephone, but instead causes a screeching sound from a small megaphone-shaped apparatus known as a "howler." This instrument is installed at the ranger station telephone and is said to give effective notice that some one is on the wire. If the field man needs to talk with some one elsewhere on the line, the ranger station instrument can be used to ring up the person wanted ,when the conversation can be carried on.

MILITARY ENGINEERING.

BY CAPTAIN RICHARD PARK,
Corps of Engineers, U. S. Army.

(Continued.)

Construction and Destruction of Obstacles.

In addition to the duties of the engineers in connection with location and construction of field intrenchments, they are charged with the construction of obstacles calculated to impede the advance of the enemy in an attack, with the mining operations in underground warfare, with the demolition of any facilities or devices which will assist the enemy, or of obstacles that will impede the operations of their own forces, and with the construction and operation of field searchlights, flares, and other devices for illuminating by night the enemy's works, and the approaches to their own works.

The object of obstacles is to protect works from surprise, to reduce the momentum of attack breaking up the enemy's formation, and holding him under the accurate fire of the defense. They should be invisible from the direction of approach, difficult to destroy and should afford no screen or cover to the enemy.

The form of obstacle most commonly used consists of a barbed wire entanglement made by stringing barbed wire loosely between poles firmly driven into the ground. The wire must be securely nailed to the pole, and every measure taken to anchor the entanglement as a whole to the ground so that it can not be readily uprooted. Previous to the war, text books taught us that wire entanglements should be from 50 to 100 yards in advance of the firing trenches. They are being employed in front of the European trenches at distances between 20 and 50 yards in front of the works. They should be at least 30 ft. wide to be effective. A portable wire entanglement can be constructed by nailing strips of wood in the form of crosses along a straight timber, and stringing barbed wire between the cross arms.

Other obstacles are made by felling trees toward the enemy, leaving them attached to their stumps, cleaning out the foliage and small branches, sharpening the large branches pointed toward the enemy. Land mines consist of small charges of dynamite buried a foot or two beneath the surface of the ground and electrically discharged during the passage of troops amongst them. While but little actual damage is caused to troops by these, their moral effect when fired is very great. Backing up the water of a stream so that it overflows a considerable area forms a good obstacle even though it can be forded. The difficulty of fording can be increased by first constructing low wire entanglements in the area to be flooded. To accomplish such work of course the dam-site must be within the defenders' lines or thoroughly protected by its artillery.

Other forms of obstacles are in common use in the present war, such as planks full of spikes, points turned upward, scattered amongst the barbed wire entanglements, crow's feet or many sided iron crosses whose arms are sharp pointed and so arranged that two or more of them will always point up. Military pits with sharpened stakes projecting upwards at the bottom, used to be very effective, but nowadays the artil-

lery can easily destroy these, using high explosives. Electricity is made use in a most effective way in the first stages of an assault. Wires are concealed amongst the barbed wire entanglements and the circuits given a high voltage charge. The ground forms part of the circuit so that when the advance troops come in contact with the live wire many of them are electrocuted. This is an effective means to prevent surprise attacks, but when the assault is preceded by an artillery bombardment, the wires of the electric circuits are usually broken. Another modern obstacle is poisonous gas, used also in the attack, pipes or receptacles filled with chlorine gas are concealed in the foreground of a position, and the gas is permitted to escape at the moment of attack.

Besides his duties in connection with the construction of obstacles, the military engineer is charged with the destruction or demolition of any facilities or devices that will assist the enemy or impede the progress of his own troops. Before an infantry attack can be launched with any chance of success, against an intrenched position protected by barbed wire entanglements, it is absolutely essential that passages be first cut through. In the Russo-Japanese war the engineers were detailed to precede the infantry line and cut passages through the wire entanglements and other obstacles. In the attack on one of the Laioyang defenses, eighty engineers cut the wire entanglement and engaged the Russians hand to hand. Only ten of them were unhit. In the present war it would seem that the artillery high explosive shell is being used effectively in leveling obstacles, in preparation for the infantry assault.

One of the important requirements of a fortified position is a clear field of fire for some distance in front of the firing trenches. Formerly we were taught that the foreground should be cleared to the effective range of the small arm—at least 1000 yards. No attempt is being made in the present war to clear the foreground for a distance greater than 300 or 400 yd., and a field of fire of 100 yd. is regarded as satisfactory if it cannot be increased without loss of concealment. It is the duty of the military engineers to provide for the clearing of the foreground of trees, brush, hedges, buildings, walls, growing crops and other cover that would be of use to the enemy, including the filling in of depressions or sunken roads. Wooden buildings, hay stacks and other inflammable objects can be destroyed by fire. Other structures can be dynamited. Crops that would afford protection such as sugar cane or corn must be cut or dragged.

A most important phase of demolition work is the destruction of transportation and supply facilities in rear of a retreating army, in order to prevent unhindered pursuit by the enemy. This work entails the destruction by fire or explosives of bridges and culverts, the sinking, burning or carrying off of boats, blocking tunnels, destruction of railroads, railroad buildings, and rolling stock, cutting telephone or telegraph lines, blowing up highways at critical points, destruction of abandoned defensive works, ammunition plants and arsenals. The duty of the engineers of the pursuing army is of course the hasty reconstruction of all of these features necessary for further advance. For this work of demolition our engineer troops are equipped with what is known as a demolition outfit consisting of the necessary tools, explosives and transportation.

Military mining consists in the sinking of shafts and driving tunnels to points under or in the vicinity of hostile works, the excavation of chambers or pockets at the extremities of the tunnels, the placing therein of explosives and the firing of the charges. The object of the explosion is either the destruction of hostile works or the formation of great holes or craters near or within the enemies' lines which can be occupied and held by the attack. The primary requisites for subterranean excavations are accuracy of direction, preventing of caving, ventilation, drainage and lighting. In former wars mining was generally confined to siege operations. In the trench warfare of the present conflict hardly a day goes by but what the newspapers report the explosion of a mine with resultant loss of life, and the occupation of the crater by one side or the other. There is always danger that counter mines of the enemy will be met and then the side which can get its mine charged and fired first is the winner for the time being. Sometimes hostile mines run by or overlap each other, and it is possible for one side to locate the tunnel of the other by means of listener galleries, which are small side tunnels dug very quietly toward the sound of talking or toward the noise made by the picks and shovels in the hostile gallery. Such galleries are enlarged into mine chambers at proper distance from the enemy gallery, charged and fired, with the resulting destruction of the gallery and the enemy miners at work therein.

The military engineers' duties in the construction of obstacles, in demolition work, and in mining operations, absolutely require that the men who perform them shall have had prior experience and training along these lines. In the employment of inundations for obstacles the hydraulic engineer is needed. The engineer officer must be enough of an electrician to know how to string his wires and insulate them amongst the barbed wire entanglements and how to get and operate a source of electric power. He must be an expert in the handling of explosives so that if he is ordered to destroy a great railway steel truss bridge, he will know what are the members most vulnerable to attack, and further the amount of explosive necessary to destroy such members. The engineering features involved in mining work are perhaps the most complicated. It takes considerable skill to sink a shaft under fire, properly timber it, break out a tunnel or gallery from the bottom, drain and ventilate it, and dig it so that its head will reach a previously designated point at a definite depth below the ground some hundred yards away, especially when you consider that the cross section of such galleries is usually quite small. The officer in charge of the mining operations must know the quantity of explosives necessary to form the sized crater that is ordered, or to destroy the enemies' works, proper allowance being made for the distances between mine and objective, both vertically and horizontally, and for the character of soil, whether it be clay, sand, hardpan or what.

(To be continued.)

FEASIBILITY OF WESTERN ELECTRO-METALLURGY.

BY DORSEY A. LYON AND ROBERT M. KEENEY.

(Continued.)

Ferro-alloys.

Ferro-alloys are manufactured by reduction of ores with carbon or some other reducing agent such as silicon or aluminum in the electric furnace. In ferro-alloy manufacture the electric current is used simply for the heat contained, and not to cause electrolysis, and so an alternating current is preferable to direct current for this purpose. The advantage which the electric furnace has over the combustion furnace in the manufacture of ferro-alloys is due to the fact that many refractory oxides which cannot be reduced to metals at the temperature of the combustion furnace are easily reduced at the higher temperature of the electric furnace.

As the purpose of this report is an inquiry into the possible market for power in the electro-metallurgical industry, we will consider the possibility of manufacture at The Dalles of only those ferro-alloys which are manufactured today by the electric furnace process in sufficient quantities to be large consumers of power. The ferro-alloy most used in the steel industry is ferro-manganese. To date, however, it has not been successfully manufactured in the electric furnace on a very large scale as compared with blast furnace ferromanganese, largely because of the cost of production in the electric furnace. Ferrosilicon and ferrochrome are made in the electric furnace in such large quantities as to be large consumers of power. There are several other ferro-alloys made almost entirely in the electric furnace such as ferrotitanium, ferrotungsten and ferro-vanadium, but the power consumed by each is so small that they are not especially important as power consumers. A plant manufacturing ferrosilicon and ferro-chrome could make these alloys.

Ferrosilicon—Raw material and labor. The raw materials necessary for the manufacture of ferrosilicon in the electric furnace may consist of wrough iron, cast iron or steel turnings or iron ore, quartz or sand, and charcoal, coal or coke. The choice of the source of iron depends chiefly on the cost of the material. Iron in form of turnings is more commonly used than iron ore, because the power consumption is lower. Some manufacturers also claim that the operation of a furnace on iron turnings is more steady than on iron ore.

For supplying silicon in the charge, quartzite is preferable to sand because it is more pure, and thus does not form as much slag to clog up the furnace. The quartzite is usually crushed to about 2 in. or less in size.

The use of charcoal, coke or coal depends largely upon the cost of these materials. As the material is used only as a reducing agent and as no strength is necessary to support the charge, due to the absence of a shaft in a ferrosilicon furnace, the cheapest and purest reducing material available is used.

While it has been estimated that from 60 to 100 tons of iron and steel borings or turnings are produced per month in Portland, we believe that iron ore would be the most satisfactory and cheap form of iron for the manufacture of ferrosilicon The supply of borings and turnings would probably prove unsteady, due to the fact that it is coming from one town, or perhaps from Seattle or San Francisco, which would raise the cost. It is not possible to purchase from another nearby source, as there is no other local source. The cost of iron or steel turnings at The Dalles would be in the neighborhood of $6 to $8 per ton. About 1200 lb. of this scrap iron would be necessary per long ton of ferrosilicon, costing at The Dalles from $3.24 to $4.21. This price would fluctuate considerably depending upon the demand for scrap iron. If an electric furnace steel plant were also located at The Dalles, there probably would not be enough turnings for both, as it is a convenient form of scrap metal to use in electric steel manufacture. The steel plant would then get all the turnings, as it could afford to pay over twice as much for them as the ferro-alloy plant. It has been estimated that Chinese iron ore containing 60 per cent iron can be laid down at The Dalles at a cost not exceeding $5.00 per ton. About one ton of this iron ore would be required per ton of ferro-silicon manufactured containing 50 per cent silicon.

The most available deposit of siliceous material near The Dalles is a bed of diatomaceous earth located two or three miles south of The Dalles. This material analyses:

SiO_2	82.70 per cent
Loss on ignition	11.07 per cent
Fe_2O_3	2.90 per cent
Al_2O_3	3.20 per cent
Total	99.87 per cent

While this material is not very high in silica, it contains no very harmful impurities, as 11.07 per cent of them are lost on ignition. One disadvantage to the use of this material in the electric furnace lies in its powdery form, as there would be a high dust loss. The cost of this material at the plant should not exceed $2 per ton. Owing to the possibility of high dust loss, it is probable that two tons of siliceous material would be required per ton of 50 per cent ferrosilicon produced, costing $4.

Charcoal would be the most satisfactory form of carbon to use for a reducing agent in the manufacture of ferrosilicon at The Dalles, both on account of its cheapness as compared with coke and greater purity. While it has been stated that it would be produced for $8, we will use $9 per short ton as the cost of charcoal at The Dalles. Coke would cost at least $10 and cause more slag in the furnace because of its ash than would be the case with charcoal. Labor requirements in the manufacture of ferrosilicon are the same as in aluminum manufacture.

Power. A ferrosilicon plant requires alternating current at a voltage of from 40 to 100 volts, the larger the furnace the higher the voltage necessary. Transformers would be used to lower the voltage from 11,000 volts to 40 to 100 volts. Allowing for a 5 per cent loss of energy in the transformation and for line loss to the furnace, the cost of power per horsepower year delivered at the furnace would be $10.52 per horsepower year. On the basis of a 90 per cent load factor the cost of power at the furnace would be $11.70 per horsepower year, or 0.18 cents per kilowatt hour.

Cost of production. Our estimate of cost of production of ferrosilicon at The Dalles is based upon a plant consuming 5000 horsepower in production of

about 3200 tons of 50 per cent ferrosilicon per year, which would be equal to a good sized European plant.

Cost of Production of 50 per cent Ferrosilicon per ton (2240 lb.)

1 ton of iron ore at $5.00 per long ton	$ 5.00
2 tons of siliceous material at $2.00 per long ton	4.00
1500 lb. of charcoal at $9.00 per ton	6.75
50 lb. of electrodes at 5 cents per lb	2.50
9700 kw.-hr. at 0.18 cents per kw.-hr	17.46
Labor	12.00
Repairs and maintenance	5.00
Amortization, depreciation at 5 cents each	2.00
Interest at 6 per cent	1.20
General and packing	4.00
Total	$59.91 per long ton

In round numbers we estimate the cost of producing ferrosilicon containing 50 per cent silicon to be $60 per long ton. The cost of this material laid down in Pittsburgh, the principal market would be about $70 per ton. To this freight charge should be added $3.50 for selling expenses, making the total cost f.o.b. Pittsburgh $73.50 per long ton.

Market. Practically all ferrosilicon containing about 50 per cent silicon or more is sold through Pittsburgh, New York or Philadelphia. Pittsburgh is the chief market. The price of the 50 per cent grade has varied for the past two years from $70 to $75 per long ton f.o.b. Pittsburgh. A company to be certain of success would have to be able to produce the alloy laid down in Pittsburgh at a cost considerably under $70 per ton, say $60 per ton. Hence it is evident that ferrosilicon manufactured at The Dalles for $73.50 per ton f.o.b. Pittsburgh would not stand much chance of being sold at any profit.

It is difficult to estimate the consumption of electric furnace ferrosilicon in the United States, but it is between 10,000 and 15,000 tons. Of this 9257 long tons were imported during the year ending June 30, 1914. The duty during this importation was 20 per cent ad valorem, but it is now reduced to 15 per cent ad valorem. It is difficult to estimate the production in the United States. There is a market for ferrosilicon in the United States, but financial success requires a lower cost of production than our estimate shows.

Conclusion. We are of the opinion that the manufacture of ferrosilicon at The Dalles would not prove to be a profitable enterprise, because we do not believe that the alloy can be produced at a low enough cost to compete succesfully with foreign ferrosilicon, which can be laid down very cheaply in the United States. Foreign ferrosilicon includes that manufactured by the Canadian plant at Welland, Ontario.

We base this conclusion almost entirely upon the estimate that ferrosilicon manufactured at The Dalles could not be sold f.o.b. Pittsburgh at less than $73.50 per ton without losing money. The high cost of manufacture at The Dalles is caused by the cost of reducing material, siliceous material and labor. To this must be added a high freight rate upon the finished product. Market conditions are excellent for the sale of domestic ferrosilicon, but it must be produced at about $60 per ton f.o.b. Pittsburgh. A 5000 horsepower plant would manufacture about 3200 tons of ferrosilicon per annum, which would be about one-third of the present imports. However, although a good market exists for the sale of this product, we do not believe the manufacture of ferrosilicon at The Dalles would be successful financially.

Ferrochrome—Raw materials and labor. The raw materials essential for the manufacture of ferrochrome are chromite and charcoal, coal or coke. For reducing material charcoal would be the best to employ at The Dalles for the reasons stated in the discussion of ferrosilicon. About one quarter of a ton of charcoal costing $2.25 is required per ton of ferrochrome. The raw materials should be of the highest purity possible. Foreign manufacturers use only chromite containing less than 0.1 per cent phosphorus and sulphur and about 50 per cent Cr_2O_3. They use no lime in the charge, as it has been found preferable to use pure materials and keep the amount of slag as low as possible.

The most available source of chromite for use at The Dalles would be California chromite. An analysis of California chromite is as follows:

Cr_2O_3	52.65 per cent
FeO	15.30 per cent
Al_2O	11.40 per cent
MgO	16.32 per cent
SiO_2	3.40 per cent

This ore can be purchased in San Francisco at from $12 to $15 per short ton, and could be laid down at The Dalles at a maximum cost of $18 per ton. One and one-half tons of chromite costing $27 are required per ton of ferrochrome produced. Labor requirements are the same as in aluminum and ferrosilicon manufacture.

Power. The same power equipment as regards transformers would serve for a ferrochrome furnace as for a ferrosilicon furnace, and the cost of electric power at the furnace will be taken at the same, $11.70 per horsepower year or 0.18 cents per kilowatt hour.

Cost of production. In estimating the cost of production of ferrochrome at The Dalles, we assume a plant capacity of 3000 horsepower producing 2500 tons of ferrochrome per year. The ferrochrome is to contain 60 per cent chromium and 8 to 10 per cent carbon.

Cost of Production of Ferrosilicon per ton (2000 lb.) at The Dalles.

1½ tons of chromite at $18 per ton	$27.00
500 lb. of charcoal at $9.00 per ton	2.25
40 lb. of carbon electrodes at 5 cents per lb	2.00
6335 kilowatt hours at 0.18 cents	11.70
Labor	15.00
Repairs	4.00
Amortization, depreciation at 5 per cent each	2.50
Interest at 5 per cent	1.50
General and packing	4.00
Total	$69.95 per ton

We estimate the cost of producing ferrochrome containing 60 per cent chromium and 8 to 10 per cent carbon to be about $70 per ton. The cost of this material f.o.b. Pittsburgh, the principal market, would be $80 per ton. To this there should be added $5 for selling expenses, making the total cost f.o.b. Pittsburgh $85 per ton.

Market. The consumption of ferrochrome in the United States has been as high as 8000 tons per year, practically all of which except 500 to 1000 tons is manufactured in the United States. So it is evident that the present domestic production practically supplies the consumption. The 8 to 10 per cent carbon ferrochrome sells for from $100 to $130 f.o.b. Pittsburgh. The duty on this grade is 15 per cent ad valorem.

Conclusions. Ferrochrome could be manufactured at The Dalles and laid down sold in Pittsburgh at a profit of $15 per short ton, but there would be such

strong domestic competition in the sale ot the product that the success of a company making this alloy would depend entirely upon the sales department. The production of 8000 tons per annum would not require over 10,000 horsepower, and with the market crowded as it is we do not believe it would be safe to start with a plant capacity of over 1000 horsepower producing about 800 tons per annum. If this was successful, the capacity could be gradually increased. Of course the cost of production with a smaller plant would be a little larger than the estimated cost. The ultimate capacity of a successful plant would not probably exceed 3000 horsepower.

(To be continued.)

PHOTOMETRY OF THE GAS-FILLED LAMP.

The new high efficiency gas-filled lamp introduces variables not hitherto encountered in the photometry of incandescent electric lamps. On account of the comparative broadness of the filament spiral and the dissymmetry of the filament mounting, there is considerable irregularity in the distribution of the light about the vertical axis. Consequently, when the lamp is rotated, as is commonly done in rating lamps at the factory, the light as seen in the photometer flickers so excessively as to render accurate measurements of candlepower practically impossible without the use of auxiliary apparatus. However, as is sometimes done, if two mirrors inclined to each other be placed back of the lamp, the flickering is so much reduced as to permit accurate candlepower measurements even at very low speeds of rotation.

But this expedient does not eliminate the most serious trouble caused by rotation. It was found that at constant voltage both the current consumed and the candlepower are different when the lamp is rotating than when it is stationary, the current changing in one direction and the candlepower always in the opposite direction; that is, there is a change in the operating efficiency of the lamp. Furthermore, this change in efficiency may be either positive or negative, depending upon the speed, and it is about twice as great when the lamp is rotating tip up as when it is rotating tip down.

Fortunately, from the standpoint of photometry, there is for each lamp in either position a particular speed at which the current and the candlepower have the same values, respectively, as when the lamp is stationary. Hence, with the lamp rotating at this speed its candlepower can be measured with accuracy in spite of its rotation. The speed for the above condition is practically the same for all lamps having the same number of loops in the filament; but for lamps having different forms of filament mounting it varies from lamp to lamp, being greatest for those having the smallest number of loops in the filament.

If the above precaution as to speed adjustment is not observed and lamps are rated while rotating at speeds ordinarily used in photometering vacuum lamps, the errors which enter may amount to as much as 1 to 2 per cent in current, or watts, in one direction, and as much as 15 to 20 per cent in candlepower in the opposite direction. Hence the voltage found for a desired operating efficiency may be so much in error as to give a lamp on test at this rated voltage a fictitious life value three or four times as large as the lamp would give if it were operated stationary at a voltage corresponding to that efficiency which during the rating was only apparent. That is, the lamp may be given credit for a much longer life than it really deserves. On the other hand, the speed may be such as to cause errors in the opposite direction resulting in a lamp life much shorter than would be expected from the apparent efficiency rating.

Another peculiarity of the gas-filled lamp is that while it burns the blackening occurs, not all over the bulb in approximate proportion to the light distribution as in the vacuum lamp, but principally at the top of the bulb because the volatilized material is carried upward by the gas. Hence in making a life test a true measure of the reduction in total light during the life of the lamp can not be obtained, in the usual manner, by mean horizontal candlepower measurements, but by determinations of the total flux or mean spherical candlepower. This is accomplished most rapidly and conveniently by means of an integrating photometer, such as the Ulbricht sphere, in which the lamp is measured stationary, and thus all the complications arising from rotation are entirely avoided.

As to the cause of the variations observed in candlepower and efficiency when the lamp is rotated, it is concluded from the results of a number of special tests that the whole effect is produced by a change in the convection currents of the gas, a consequent variation in the temperature distribution in the bulb, resulting in a change in the resistance, and therefore a variation in the current and candlepower of the lamp. —Scientific Paper No. 264 U. S. Bureau of Standards.

A field water purification plant of the ultra-violet-ray sterilization type was recently designed and installed by Captain F. A. Dallyn to provide a better water supply for Canadian troops in camp. As described in the Canadian Engineer, polluted water is pumped from the Niagara River through a mechanical filter of the reverse-flow type, mounted on a four-wheeled wagon. From this it goes to the sterilizing apparatus, passing through three quartz tubes, to each of which is attached an ultra-violet-ray lamp, the emanation reaching the water through the quartz. The tubes, 4 in. long by 1½ in. diameter, are carried in a casting, and water-tight joints are secured by means of rubber gaskets. Three windows are provided in the casting, through which the operator can watch the lamps, etc. The outfit includes a Westinghouse generator, engine, and Albany pump. Current is supplied by a 2½ kw. 220-volt direct-current dynamo; the pump is a 2½ in. water-sealed rotary type machine, with a capacity of 3000 gallons at 250 r.p.m. These are driven by a 9 h.p. Lister vertical petrol engine, fitted with automatic pump lubrication, enabling it to run between 200 and 250 hours without refilling the oil chamber, pump-fed carburettor, etc. It has reduced the normal count in raw water of 4000 bacteria per c.c. to from 10 to zero. Colon bacilli were commonly present in 0.01 c.c., but after sterilization were normally absent in 50 c.c.

SOME PROBLEMS OF INDUCTIVE INTERFERENCE.

(This discussion on the paper of this title published in these columns April 15, 1916, was held at a joint meeting of the Portland A. I. E. E. and N. E. L. A. Sections, Jan. 11, 1916. The remarks are confined primarily to criticizing the inductive interference order of the California Railroad Commission. —The Editor.)

J. C. Martin: To those not familiar with conditions in California, the first impression is that the order places in the hands of the telephone interests, the power to dictate almost anything they choose in the construction of paralleling power lines and their connected apparatus. Naturally, that excites a power man. We have felt that the order is tentative.

Referring to the letter of transmittal, we note that the committee itself makes such a statement, and furthermore, in the discussion of the report, the statement is repeated. The feeling of the power men has been that until a more definite knowledge of the problem involved and satisfactory means of remedying the troubles are obtained, it is not advisable for any state outside of California to adopt such an order. The thing we have looked at is the order. Without any definite knowledge of California conditions, it has been interpreted by power men simply as it reads.

So far as we of the Northwest are concerned, (speaking for myself and for the committee of the Northwest Electric Light & Power Association as a whole) we are ready to meet any of the telephone representatives on any cases of trouble they may have. We are willing to discuss the matter, and reach any settlement that we can see is reasonable and involves mutual responsibility.

There has been considerable comment upon the fact that the California order contains nothing that indicates any great amount of investigation on the part of the committee as to what could be done on the telephone plant or its equipment to remedy troubles claimed to exist. I don't know what has been done, though I understand that what has been done has been done largely by the telephone interests. They state that they have gone very fully into the question but have failed to find any means of solving the problem. The feeling of power engineers is that there should be a much more thorough investigation made of this phase of the subject and that the investigation could be carried much further than it has been in California if some independent investigating body that would be free from any suspicion of bias one way or the other could take hold of the work. It is a subject that few or none of the power men know anything about. I presume that further study will reveal that what has been done so far has only scratched the surface.

One feature that Mr. Griswold has touched upon that we consider of extreme importance is the economic feature. Both industries must assume a fair share of the burden. The public, in the end, must pay for the cost of solving the problem, and it must be solved on the basis which will render the greatest benefit to the public at the least cost. In other words, nothing can be done that will allow the extension of one service to a community to the partial or complete exclusion of the other.

J. B. Fisken: There is very little in the paper that offers a subject for discussion. We all agree with Mr. Mastick in what he has stated, and if there is going to be any discussion at all, it seems to me the only problem we have is the California order. The California order, as we are told, is very satisfactory, and is working out very nicely in California. If that is so, I have no doubt the California conditions must be very different from the conditions in the Northwest, because it would not work out at all with us.

Up to about twenty years ago the tendency as regards the building of cities was to locate them where coal mines were, or immediately at water falls, so that cheap power could be had. But nowadays, since the development of the multiphase system of electric transmission, other considerations enter into the locations of towns. Twenty years ago the miner was under the necessary of developing power with coal, or some other fuel, but on the Pacific Coast today, and indeed almost all over the United States, he is furnished with cheap electricity. Twenty years ago irrigation was almost unknown except where a gravity system could be had. Today on the desert, which not so very long ago was the home of rattlesnakes and jackrabbits, we have a veritable garden of Eden. All these changes are due to cheap electrical power. The people, generally, have benefitted from this transformation, and the telephone interests have, undoubtedly, benefitted also. It would be a mistake economically to do anything that would tend to destroy the power industry or to unnecessarily retard it, and a study of the California order will show, I think, that in many cases, the growth of the power industry would be seriously impaired if we had an order such as this to work under.

A great deal can be done by co-operation. We, in Spokane, have endeavored to co-operate as far as we possibly can. We have not spared expense where in our opinion it was necessary to protect the telephone company's service. I might cite the case of one line we built a year or two ago, where we went to very considerable expense in order to avoid building along the same road that was already occupied by a telephone toll line. It increased the expense of that part of our construction about twenty-five hundred dollars. At one place we had to buy a right-of-way for three miles through rock piles, where almost every pole hole had to be blasted. We had also to build a road in order that we might get the material in. That is only one case but there are others, and we have in every way possible endeavored to keep from injuring the telephone interests. In another case it was with the same idea of not injuring the telephone interests by interfering with their line that we located a new line as far away as possible from the telephone toll line. It necessitated buying easements for miles. It necessitated a clearing of heavy timber, and we did all that and built the line. It wasn't very long before the telephone company cast its eyes on that beautiful straight clearing, and they abandoned the line along the road and built a new line on our right-of-way which paralleled our line for several miles.

Under the California order, if it applied in Idaho, the telephone company could require us to rebuild our line. That does not strike us as being fair. We were there first and went to the expense of making the clearing, and then to have them come in and require us to rebuild our line would strike any fair man as being unjust. We don't object to the telephone company using our right-of-way and our road, but we would object, and most strenuously, to completely rebuilding our line on that account. The industry, or the manufacturers rather, are not forgetful of the situation, and they realize, and have realized for some time that the present form of electrolytic lightning arresters has caused a lot of trouble to the telephone interests. They have been working on the line of an electrolytic arrester that will not require charging. They have developed that arrester to the point where it can be used up to 15,000 volts, and it is only a question of time when it can be used to 60,000 and 100,000. Ultimately we will get an arrester that will not require charging, that will eliminate almost entirely the interference due to charging lightning arresters. We have gone to a considerable trouble and expense to charge our lightning arrester at a time that is suitable to the telephone interests, but if we had to hire a man to get up between two and three o'clock in the morning to charge the lightning arresters and do nothing else it would put a great burden upon us, as that man would be of no use the rest of the day. It is not reasonable to require that.

I admire greatly the work done by this committee in California. It is a splendid work. I would like to repeat what I said in San Francisco when Mr. Babcock submitted a report

of progress. I stated that in my opinion, the electrical fraternity, not only of the United States, but of the world, was indebted to this committee for the work it had done. I don't consider, however, that it is fair to impose the burden upon this committee of continuing that work, and in my opinion, it should be taken up by some national body. At the time I made the suggestion I had no idea what national body would naturally do this, but since then the suggestion has been thrown out, and it is a splendid one, that the Bureau of Standards should take up this work, and make a thorough investigation to satisfy us that the telephone company was doing all it could reasonably be expected to do, and to satisfy the telephone company that the same requirements were being met upon our part.

Incidentally, I would call your attention to the fact that there are some things that the telephone company does not know about their own apparatus. We have been assured time and again that the standard fuse is only good to protect up to 5000 volts. The Bureau of Standards discovered that it was safe up to 7500 volts, and probably a good deal higher. As a result of that discovery the code which the Bureau of Standards is now working on, will provide that the highest grade of construction for crossings will only be required in cases of over 7500 volts instead of 5000 as we have heretofore been told was the limit. I believe a great deal could be done in the way of co-operation, and if the telephone interests desire, I am perfectly sure that our committee—and we represent practically every power company in Oregon, Washington and Idaho—will be more than glad to meet with them at any time, and go into this question and see what can be done, and all I ask of the telephone interests is to forget the California order.

F. D. Nims: Sometime before the California ordinance was brought to notice in Spokane, I had a few differences with the telephone company in British Columbia. We fought things over for two years, and finally, came down to an agreement, and since that time things have been adjusted in a friendly way, satisfactory to both sides. But, it wasn't along the lines as laid down by the California commission. There are several points in there I might call your attention to. One is, that the rulings of the California commission cover any communication circuit. That, if applied to the states of Oregon and Washington, and particularly the company I am connected with at the present time, would mean we would have to go out of business, because we are in a district that is the most heavily timbered in the Northwest, and almost the only communication circuits there are little farmer lines. They generally go out of business in September, and they do not fix them up until May again. Sometimes they are out of service for three or four months of the year. We would be compelled to put up the construction which would absolutely prohibit getting business, as we could not stand the expense.

The form of the California ruling is a little long and the language is somewhat indefinite. In one instance, there was an appraisal of four communication companies. Under the California ruling every one of these would have to space his transmission off or we would be compelled by the commission to get together and get some kind of a joint ruling. In the definition of a "parallel" which separation constitutes a parallel? That is probably determined upon by the circumstances. But, we have today, a few difficulties with one telephone circuit from the charging of the electrical arresters on the circuit of another company, which are twenty miles away. They parallel us for a distance of about thirty miles across Puget Sound. Every time they charge their arresters our telephone line is out of business for a minute or two. Again, it is just the other way around, and when we charge our arresters they find that the same thing happens on their telephone lines, but I have talked to several people of the telephone company, and they have not noticed it. A telephone line runs parallel to us and 60 ft. away for twenty-four miles and they do not feel any ill-effects from the charging of our arresters. This is one of those points which I think brings back the point Mr. Martin made, and this point should be more thoroughly investigated before any laws are laid down, laws which are as mandatory as the California laws.

V. H. Greiser: In listening to the remarks this evening, co-operation seems to be the principal thing brought out, and I assume from that that when the power companies hand the telephone companies a bat in the ear or vice versa, the telephone companies are going to turn around and hand the power companies a bat in the ear.

Some four years ago I had the pleasure of meeting Mr. Griswold in Spokane, and the subject of "Interference" was brought up I think with reference to the very line Mr. Fisken described. In the conversation with Mr. Griswold I told him I didn't believe that firm knew what to do. They didn't know enough about the telephone business to make up their own mind what charge they should make in operation or construction, and I asked him a frank question what we could could do. Griswold very frankly replied that he didn't know himself at that time. He then described the situation to me as it was in California. That is, that the committee was in the process of formation, and until they had made their investiagtion it would be impossible to tell who should do anything or whether anything could be done. Our power engineers have been much interested in what has been published of the committee's report of California, but, on the other hand, the power engineers and operators have been very much disappointed in not securing more in detail of the test processes and detailed results as this investigation was carried along. In other words, the power engineers today, outside of the committee, do not know how these conclusions were arrived at. They feel rather uncertain about them for that reason. It is all very well to have somebody tell us, "Take this medicine and you will feel better," but we would like to know, nevertheless, just what kind of medicine it is, especially since it is the first year.

There is not a power man in the country that has paid any attention to the subject whatever but would feel glad to work with the telephone company as far as possible along this subject. Of my own knowledge, I have seen the oscillograph write the harmonics and I have heard they exist from the telephone men, so I know they must get them, but we would like to know what to do so that we could be sure our efforts would bear results. So the burden is not on us completely. We are really doing part of the telephone companies' work for them. We are bound to be prejudiced in our own favor, and since the telephone men are usually only human, we have a conception that might be a little bit prejudiced to our own side of the game. For that reason it seems obvious that if an independent party could be brought into this subject to clarify it for us and make us both feel that the thing could be worked out, that would undoubtedly be the best solution for all concerned. We would have everything settled by arbitration like the International Peace Congress, which has been so successful. We would have a few things settled ourselves. It seems as though it might be advisable to allow us to reach a definite result soon. This matter should be put in the hands of some learned and independent body as has been suggested by several of the previous speakers. For instance, the United States Bureau of Standards. They have the equipment and the best scientists of the country. If they haven't any power men they can get them. There is plenty of material in the country. They only need money and equipment, and they desire to get into it and develop the real science of the situation, and until something of that character is done we all must try to co-operate. We are all of us very much tied up in our own interests and cannot always see the other fellow's side as much as we should.

(To be continued.)

A COMMENDABLE INSPECTION REPORT.

Laurin E. Hinman, electrical inspector for the City of Medford, Oregon, in submitting the annual report of the work done by his department during 1915 has set a standard which might well be followed by others. F. D. Weber, electrical inspector for the Underwriters' Equitable Rating Bureau of Portland, characterizes this work as "the most efficient electrical inspection in Oregon and a source of inspiration, as this is a city of only about 10,000 inhabitants."

During the year 2365 inspections were made and 613 permits issued. This included 1301 inspections on new wiring in business buildings, 756 newly wired residences, 250 on old wiring in business buildings and 94 old wired residences.

The nature of the installations and the kind of building in which the wiring was installed, is outlined as follows:

New business buildings wired	3
New residences wired	9
Old residences wired (not wired hitherto)	21
New building additions to business buildings	6
Additions to original installations in business buildings	236
Additions to original installations in residences	203
Repairs made to original installations in business buildings	59
Repairs made to original installations in residences	58
Business buildings rewired account hazardous installations.	5

Electric motors were installed to the number of 27 and a rating of 110.65 h.p., electric signs numbered 16, electric ranges 22, water heaters 35, air heaters 98 and hot-plates or flat rate service 18. The total value of the wiring inspected was $14,079.

Report of New Construction.

New business buildings erected 1914—6. Cost	$ 66,100.00
New business buildings erected 1915—3. Cost	115,500.00
New residences erected 1914—13.—Cost	30,525.00
New residences erected 1915—9. Cost	18,300.00
Additions to business buildings 1914—7. Cost	6,750.00
Additions to business buildings 1915—6. Cost	5,150.00
Repairs to business buildings 1914. Cost	8,720.00
Repairs to business buildings 1915. Cost	530.00
Additions to and remodeling residences 1914. Cost	3,340.00
Additions to and remodeling residences 1915. Cost	6,200.00
Flues and chimneys constructed 1914. Cost	135.00
Flues and chimneys constructed 1915. Cost	500.00
Total of building operations year of 1914	$115,570.00
Total of building operations year of 1915	$206,415.00

During November, 1915, a new street-lighting contract was entered into by the city and the California-Oregon Power Company, whereby the present arc lighting system will be discontinued and replaced by the more modern series mazda system, using the type "C" nitrogen lamp of 200 and 400 candlepower; the city to make all replacements and renewals of burned-out lamps. Beginning with December 1, 1915, this department assumed making the renewals and replacements on the cluster lighting system and upon the completion of the series mazda system, will attend to replacements and renewals thereon.

Under the new street lighting contract the saving to the city during the month of December, 1915, for street lighting, is as follows:

124-250 watt lamps at $3.00 each		$372.00
48-100 watt lamps at $1.20 each		57.60
69-3 light 40 watt clusters at $1.50 each		103.60
14-5 light 40 watt clusters at $2.50 each		35.00
		$568.20
Allowance of 3 per cent of gross revenue inside city, exclusive of city bill	$137.96	
Amount allowed city (15 per cent) for making renewals	85.24	
	$223.20	
Cost of making renewals for December, 1915.	8.145	
	$215.055	$215.055
Total cost of street lighting for December, 1915		$353.145
Cost to city under old contract $685.35.		
Saving to city under new contract		$332.205
		$685.350

Master electrician's licenses were issued to the Medford Electric Company, Paul's Electric Store and Electric Construction Company.

Street lighting inspection required 226½ hours, public call and fire alarm system 93 hours and gravity pipe line telephone system 196 hours.

LETTERS TO THE EDITOR.

The Need for Teaching the Dealers.

Sir:—We heartily approve of your editorial on the subject of educating the dealers, as we believe that the large majority of the dealers do not have the proper understanding of costs of electric service and consequently cannot properly handle their sales arguments.

There is one point, however, that I believe you have overlooked in connection with this important problem, and that is that a certain amount of educational work must be done by the central stations with the customer before some classes of business are developed to the point where the dealer can profitably handle same. An especially good illustration is the electric range situation. The majority of central stations feel that as long as the present prices of ranges continue, ranges will have to be sold at practically cost and on deferred monthly payment basis. The dealers naturally cannot afford to handle this business, yet they are interested in having the range business go ahead rapidly, due to the fact that it results in a great deal of additional wiring and leads to more extended use of household appliances. Again, just as soon as range sales increase materially, prices, due to competition and to larger production on the part of the manufacturers, are bound to drop, at which time central stations undoubtedly will be only too glad to arrange their selling prices so the dealers can handle ranges.

I feel that all of the varied interests involved in the electrical merchandising problems should recognize the importance of quickly developing new uses of electricity and the importance of using special policies to accomplish this purpose.

You undoubtedly appreciate that one of the points involved is the necessity of selling central stations, during the development period, this special merchandise at prices as low as materials are sold the jobbers.

W. R. PUTNAM,
Sales Manager Utah Power & Light Co.
Salt Lake City, Utah, April 12, 1916.

Sir:—Regarding your editorial appearing in the Journal of the 8th instant, entitled "The Need for Teaching the Dealer," I entirely agree with your statement that all interested will get the best results when the intelligent co-operation of the dealers is obtained.

As you are aware, our company is spending a great deal of time and money in helping to develop the dealers throughout territory served by it. We can already see goods results from this work and look for better results as the work continues.

I believe this is a work that must be followed up very actively by the central stations, jobbers and manufacturers, as well as the press, and I hope you will continue your efforts along this line.

S. V. WALTON,
Manager Commercial Dept. Pacific Gas & Elec. Co.,
San Francisco, Cal., April 11, 1916.

JOURNAL OF ELECTRICITY
POWER AND GAS

FOUNDED 1887

PUBLISHED WEEKLY BY THE

Technical Publishing Company

Crossley Building, San Francisco

ON LIBRARY CARS OF ALL SOUTHERN PACIFIC TRAINS

TERMS OF SUBSCRIPTION.

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	" "	3.50
Other Foreign Countries within the Postal Union	" "	5.00
Single Copies, Current Month	each,	.25

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Change of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

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A Remarkable Engineering Feat

Unusual conditions of construction call for unusual means to meet them. The method of grouting a loose gravel foundation encountered after construction had been started on the Klamath River dam of the California-Oregon Power Company, as described elsewhere in these columns, is suggestive as to its application elsewhere.

While an engineer would not knowingly undertake such a task the exigencies of this case made it necessary continue after an undesirable dam site, as regards foundation, had been found. The owners were urging haste in constructing the dam and the situation had to be met by some immediate expedient. Hence the decision to grout two curtain walls to a depth of nearly one hundred and fifty feet below water level. So far as is known, no similar work has been done elsewhere. With the successful completion of this job it is thought that the methods might well be applied to the other sites where bed rock is at some distance from the surface.

The main lesson taught by this experience, however, is the necessity of thorough explanation of bedrock with diamond drills before starting construction.

A Commendable Pension Plan

The decision of the directors of the Pacific Gas & Electric Company to substitute a standard pension system for the past "sympathetic" method is one worthy of emulation by other public utility companies. The justice of thus providing for the disability or old-age of corporation workers is so well established as to need no argument.

This pension plan provides for the retirement and pensioning of any employe at the age of sixty-five years after fifteen years of continuous service, of any employe who becomes permanently disabled after twenty years' or in the case of a ten-year employe disabled by injury received while actually at work. The pension allowance for each year of service is on the basis of one and one-half per cent of the average monthly pay received for the ten years prior to retirement, the minimum being fifteen dollars per month.

This is thus seen to be a straight pension plan, independent of any form of insurance or sick benefits. It is humanitarian in scope and should be most efficient in action.

Improvement Through Substitution

Opportunity consists in the answer to a need. In the electrical field at this time, the rapidly increasing cost of materials and delay in deliveries—"due to the war"—calls for vigilance and research, that economies may be effected and possibly better methods evolved. It does not necessarily follow that the better way now to be adopted must be "new." The old order—the supplanted method or discarded materials—may now offer the betterments desired.

So the lighting fixture manufacturer and dealer may now be able to induce a complete change of style in lighting equipment that will result in lighting not only more pleasing but more economical.

Lighting glassware came onto the market in answer to a need. Energy costs were high, lamps comparatively inefficient and at that were not installed to produce maximum results. The glassware manufacturers grasped this opportunity.

But the continued downward revision of rate schedules and the wonderful improvement of lamps have made unnecessary the complete utilization of light flux to the end of a bare physical efficiency, while the increased intrinsic brilliancy of the improved light sources has made it undesirable.

A partial reversion to the materials of the preglassware period in lighting—silk, cretonne and other goods, paper, transparent mica, gelatine, wood and plaster—would not, in view of other advances, show retrogression, but would result in more artistic and, especially as regards the home, in more appropriate lighting.

The Japanese advantaging opportunity—eager to capture the markets temporarily lost to the other nations and appreciating the impossibility of the general and quantitative use of expensive materials—have already placed on the market an attractive though characteristically Japanese line of cardboard and paper, wood and silk, and metal and silk shades for electric lamps. The facile faculty of imitation which that people possess has enabled them to adapt their materials in part to American designs, but the satisfactory solution and full advantage of this situation lies in the utilization of home products and native genius.

As a change is always in season and initial cost economies must be effected, an exceptional opportunity is here afforded for any who will adequately meet this need.

Suggestions for an Electric Range Week

Now that the advantage of innumerable electric range consumers rather than a few large power users has been recogniezd by electric power companies this class of business is being accorded a low rate and consequently a great number of ranges are being sold in the West. Much of this has been accomplished by house-to-house canvassing and word-of-mouth selling. Other more effective means are available and well worth consideration.

In the first place, stimulate and intensify interest by an electric range week, during which special demonstrations of electric cooking can be given by every dealer in a town. Let the central station and the several range manufacturers co-operate in an educative advertising campaign in the local newspapers, telling where demonstrations are being given. Substantial prizes might likewise be offered for the most beautiful and attractive displays by electrical dealers, house-furnishing stores and others selling electric stoves, ranges being furnished by central station or manufacturer and prizes being awarded to each class of business house participating. Each store should also conduct a guessing contest as to how many electric ranges will be sold during the month of May or June, the range on display being awarded to the nearest guesser.

Nor should the "movies" be neglected. Slides and short films on the pleasures of electric cooking should be displayed in every moving picture house. Special inducements in the way of cooking utensils as premiums will be found to have a peculiar persuasive power on women.

It is advisable to have talks on electricity given at all club meetings and schools, giving a working demonstration of electric cooking in each case. In some instances it is even desirable to present a range to a woman's club or domestic science school where it may be used by many different people.

A competition in the writing of compositions among the school children would command much attention if an electric range, electric oven, electric percolator and electric toaster were offered as prizes for the best writings on some such subject as the efficiency of electric cooking. Children's questions in the home and elsewhere are far-reaching in effect and productive of excellent results.

By simultaneous action on each of these and other plans during a week a deep and lasting impression can be made on the public mind so that the effect will be felt for many a month to come. Such a movement needs the enthusiastic united support of everybody in the electric business. Street car cards, automobile banners, bill-boards, electric signs and newspapers should all be used. Every electric salesman, whether from central station, jobber or dealer should think, act and talk electric ranges. The Jovian Leagues can do yeoman service in this respect..

Never has there been such an opportunity for every branch of the electrical industry to participate in profits as is afforded by the electric range today. The manufacturers are putting out fine ranges at reasonable prices, the central stations are offering low rates and the public is anxious to enjoy the novelty and convenience of electric cooking. Every range sold means wiring for the contractor and a profit for the dealer.

One effect of the ever operating central station-jobber campaign on lamp socket devices which has been conducted by the Pacific Gas & Electric Company during the past four months has been to demonstrate the ability of the electrical dealer as a potential load builder. The dealers have awakened to the chance that they have to sell appliances and will hereafter handle the sales without the crutch hitherto provided. Electric ranges offer even greater inducement to dealers' activity.

PERSONALS

D. E. Bailey, of the Bailey-Drake Company, of San Francisco, is at Los Angeles.

E. J. Hall, of the Electric Novelties Company, San Francisco, is confined to his home by illness.

Garnett Young, general manager Telephone Electric Equipment Company, is at Los Angeles.

G. H. Bradt, vice-president of the Wizard Electric Lamp Company of San Francisco, is at New York.

G. T. Lundie, of the Tonopah Wire & Electric Company, has returned to Tonopah from San Francisco.

E. J. Hampton, of the Hampton Electric Company, San Francisco, has just returned from a short trip.

Guy Moore, of the Moore-Rose Company of Healdsburg, was a recent business visitor at San Francisco.

H. C. Munter, Pacific Coast manager of the Hughes Electric Heating Company of Chicago, is at Los Angeles.

M. T. Cook, general manager of the Pacific Coast for the Western Union Telegraph Company, is at San Francisco.

L. S. Ready, engineer in the gas and electric department of the California Railroad Commission, is at Los Angeles.

J. M. Nightingdale, electrical contractor and dealer from Modesto, has returned home after a visit to San Francisco.

A. H. Neuland, of the Neuland Electric Company, has moved the company's laboratory to San Francisco from New York.

A. G. Wishon, general manager of the San Joaquin Light and Power Corporation of Fresno, was at San Francisco this week.

A. G. Zeitschel, formerly with the Electric Appliance Company of San Francisco, has recently joined the sales force of the Baker-Joslyn Company.

A. H. Noyes, of the Electric Appliance Company, has recently returned from a business trip throughout the northern part of California and southern Oregon.

Paul C. Butte, of the Butte Engineering Company, has returned to San Francisco from a trip in the San Joaquin Valley overlooking the installation of an electrical bridge equipment at Middle River and Old River.

P. D. Frazier has resigned as general foreman of operation and maintenance for the Great Western Power Company at Oakland, Cal., to become superintendent of construction for the Alabama Power Company, at Birmingham, Ala.

Walter B. Smith, formerly with Holabird-Reynolds Company, of San Francisco, and J. C. Hobrecht Company of Sacramento, who recently returned from an extended trip to Australia, has joined the sales force of the Baker-Joslyn Company of San Francisco.

Max Lowenthal, electrical specialist for the Dohrman Commercial Co., at San Francisco, has visited the stores of the syndicate throughout the state in the interest of the electrical departments, giving talks to the employees and reorganizing the departments.

B. C. Hill, supervisor of electric inspection for the City of Oakland, has been elected president of the California Association of Electrical Inspectors, **Frank Ellison** being vice-president and **A. J. Cleary,** secretary. The next meeting will be held at Stockton, May 8th.

Wynn Meredith, civil engineer and member of the firm of Sanderson & Porter, **G. W. Dickie,** mechanical engineer, **C. W. Merrill,** mining engineer, **A. B. Babcock,** electrical engineer Southern PacificCompany, and **Edmund O'Neill,** professor of chemistry, University of California, have been appointed California members of the National Industrial Survey by the Naval Consulting Board.

Clyde B. Aitchison, chairman of the Public Service Commission of Oregon, as announced in these columns April 15th, has accepted the position of solicitor for the National Association of Railway Commissioners, in connection with the pending appraisal of the railroad, telegraph and telephone systems of the United States being made by the Interstate Commerce Commission. Mr. Aitchison's headquarters will be at Washington, and his new work will necessitate his resignation from the Oregon commission. Considerable work now pending under submission before the commission will be cleared up before Mr. Aitchison will make his intended resignation effective. Probably his resignation will not become effective and a successor be qualified before the first of June. The position tendered Mr. Aitchison is a new one. It will be his function to represent the interests of the States and State

Commissions at Washington during the federal appraisal. The carriers have a strong organization for the protection of their interests. It was the unanimous view of the state commissioners at the annual convention in San Francisco last fall that representation by the states was absolutely required in the public interest, and members of the Interstate Commerce Commission have strongly urged the importance of the state commissions taking such action in the public interest. Up to the present time, the only appearance before the Interstate Commerce Commission in opposition to the claims of the carriers has been made by volunteers and committee from the state commissions. Mr. Aitchison has been a member of the Oregon commission since 1907, when (under the name of Railroad Commission) it was created. He was elected in 1908, and again in 1912, and his term expires in January, 1917. He was one of the joint authors of the railroad commission act, and drafted the present public utilities law. Previous to his appointment on the railroad commission, he was, in 1905 and 1906, the secretary of the Oregon Tax Commission, appointed to redraft the tax laws of the state. He has served as counsel for the Oregon commission since its organiatzion, and in more than nine years no order of the Oregon commission has been vacated by any court. Mr. Aitchison is lecturer on the law of Water Rights in Northwestern College of Law, in Portland.

George W. Martin and **J. Grant De Remer** have announced the organization of an engineering firm with offices at 100 Broadway, New York, for general practice in public utilities and industrial plants. Mr. Martin graduated from Stevens Institute of Technology in 1890. After spending several years in the heating contracting business in New York City, he became associate editor of Cassier's Magazine and later editor of the Electrical Age. Resigning to accept a position with Ford, Bacon & Davis, Mr. Martin was engaged in engineering construction work in the south. Later he was employed under Dr. Jacobus of the Babcock & Wilcox Company, resigning to organize the New York Service Company, for the operation of individual steam plants. In this connection Mr. Martin has specialized in plant operation and power costs. He will retain his interest in the New York Service Company as its vice-president. Mr. De Remer comes from the West. He graduated from the University of California in 1907, and immediately joined the staff of the Westighouse Electric & Manufacturing Company as assistant to the manager of the San Francisco office, where he remained until 1910. Upon the organization of the United Light & Power Company of San Francisco, he became its vice-president and later chief mechanical and electrical engineer, in which capacity the electrical properties and steam heating systems of that company were under his direct supervision until he resigned in 1914 to join the American District Steam Company of North Tonawanda, N. Y. On January 1, 1916, he resigned the position of manager of the general engineering department of this company to remove to New York for the purpose of entering upon this new engineering enterprise. In developing the district heating business in San Francisco, and later in examining and reporting upon heating properties in various parts of the United States, Mr. De Remer has acquired a large experience and an intimate knowledge of the heating industry, which will be a valuable assets to the new firm in that special field. The new organization will interest itself to a considerable extent in the financial development of new and existing properties. The firm will be known as Martin & De Remer.

MEETING NOTICES.

Great Western Power Co. N. E. L. A. Section.

Two meetings of this newly-organized section have been held, one in San Francisco, where P. D. Frazier read a paper on the early history of the company, and one in Oakland, where J. W. Beckman read one regarding a new electro-chemical plant at Pittsburg, Cal., for the manufacture of caustic soda and bleaching powder from sea salt and limestone. A meeting will be held in the near future to inspect the company's new exhibit of electric ranges at San Francisco.

Los Angeles Jovian League.

A pleasing and instructive diversion was provided at the meeting on April 12th, by S. J. Keese, chairman of the day, in a lecture on "Colored Photography," which was explained and illustrated on the screen by photographic slides taken in their natural colors. Herbert J. Goudge, the principal speaker of the day, discussed the theory of the spectrum, and explained with the aid of lantern slides, the process of decomposing light with the spectroscope. He was followed by T. C. Low, also an authority on spectroscopy, who explained the intricate details of color photography, and illustrated his talk with photographic slides of scenery and flowers that almost rivaled nature in their beauty of color. Dr. Dain L. Tasker and S. J. Keese also exhibited color photographs made by themselves, and it was long past the regular time for adjournment when the interesting entertainment was brought to a close by Acting President J. N. Colkitt.

San Francisco Electrical Development and Jovian League.

The league luncheon of April 12th was more or less the occasion for boosting the Jovian smoker on the 14th. Vice-president C. C. Hillis, first introduced Murray Orrick, First Tribune of the Jovian Order, as chairman of the day, who had provided an interesting entertainment. A. E. Rowe was asked to tell some of the details about the smoker and Albert H. Elliot was introduced as speaker of the day. Mr. Elliot gave a soul-stirring speech on co-operation as a means of bringing about world peace, his remarks being heartily applauded. Nearly 200 electrical men assembled Friday evening at the Jovian smoker held at a local hotel. A wealth of entertainment and refreshment had been made ready and was greatly enjoyed by all present. The active workers in arranging this affair were Tribunes Murray Orrick and E. A. Wilcox, Al Drendell, Earl Fisher, A. H. Halloran, A. E. Rowe, Wm. Neelands and H. E. Bittman, together with Tribunes F H. Woodward and B. C. Hill of Oakland, who headed a big trans-bay deegation of guests. The Oakland Jovians have invited the San Francisco Jovians to an entertainment in the club rooms of the Oakland Commercial Club at an early date. A committee consisting of Hugh Kimball, Geo. King, Julius Genzler, Lee Gilpen, Carl Hardy, Geo. Furniss and Albert Nylen, has been named to complete arrangements.

Northwest Electric Light & Power Association Convention.

Plans are being rapidly matured for the ninth annual convention of the Northwest Electric Light & Power Association at Seattle, September 6, 7, 8 and 9, 1916. The Pacific Coast meeting of the American Institute of electrical Engineers will be conducted at the same time and place, and there is also a possibility that the Pacific Coast Electrical Supply Jobbers' Association will do likewise. The following papers will be presented and discussed:

"Application of Overhead Line Construction Rules of the Public Service Commissions of the Northwest," Editor, M. T. Crawford, Puget Sound Traction, Light & Power Company, Seattle; "Effect of Obsolescence of Equipment on Cost of Service," Editor, Leslie Craven, Portland Railway, Light & Power Company, Portland; "The Employer as an Educator of the Public," Editor, Arthur Gunn, president Wenatchee Valley Gas & Electric Company, Wenatchee; "Merchandising and Operating in Small Towns and Rural Communities," Editor, ..., Pacific Power & Light Company.

Range Committee Report: W. R. Putnam, chairman; M. C. Osborne, S. V. Walton, H. J. Gille, A. C. McMicken, S. M. Kennedy.

Round Table Conference: Conducted by E. G. Robinson, president Northwest Electric Light & Power Association; "Co-operation Between Central Stations, Manufacturers, Jobbers and Contractor-Dealers," Editor, W. L. Goodwin, vice-president and sales manager Pacific States Electric Company, San Francisco, Cal.

Portland Section A. I. E. E. and N. E. L. A.

The luncheon on April 13th was held under the auspices of the North Coast Power Company. The speaker of the day was Wm. D. Wheelright and his subject was "The League to Enforce Peace." The league was formed on Bunker Hill Day, 1915, in Independence Hall, Philadelphia with Ex-President W. H. Taft as president. It was formed to establish and enforce peace after the present European war and operates through a judicial tribunal and a conciliatory council. If any one country should declare war without submitting its grievance to the proper tribunal all the others in the league would withdraw their economic forces and try to suppress same.

The regular monthly meeting was held April 11th, in the Auditorium of the Electric Building. J. E. Davidson acted as chairman, M. E. Cheney, electrical engineer, electrical inspection department, Washington Surveying and Rating Bureau, presented a paper on "The Scientific Construction of Utility Insurance Rates." The secretary read a letter from the sub-committee on exhibits for the Chicago convention asking whether or not the local section desired to send an exhibit to the convention. Upon motion, the chairman appointed a committee o fthree to investigate the advisability of

entering an exhibit from the section. The commttee consists of Messrs. Broili, McMicken and Moody. The secretary submitted a report on the joint meeting which had been held thus far this year. A new constitution and by-laws was adopted by the Institute section providing for local members paying two dollars for annual dues.

After the reading of the paper and business meeting the section enjoyed a buffet lunch. Attendance 45.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

The Martinez & Concord Interurban Railway Company has applied to the commission for authority to issue 1050 shares of its common stock at not less than $45 a share; $125,000 face value of its first mortgage bonds at not less than $90 and $125,000 of its cumulative participating at not less than par.

The Great Western Power Company has applied to the commission for authority to use the sum of $500,943.10, a part of the $1,350,000 received by the sale of the capital stock of the City Electric Company to the Great Western Power Company of California, to reimburse expenditures between June 1, 1915 and February 29, 1916, for expenditures and betterments.

The commission has issued an order authorizing the Chetco Southern Telephone Company, of Harbor, Oregon, to sell a one-half interest in the telephone system at Crescent City, Del Norte to the Del Norte People's Telephone Company. The purchase price is $2000.

The Peoples Gas Company of California in an application accompanied by applications from all the companies involved, asks the commission for authority to buy the gas properties of the Southern Counties Gas Company of California, the Long Beach Consolidated Gas Company, and the Southern California Edison Company, excepting the Santa Barbara plant of the latter corporation, for $2,750,000 par value 20 year 5½ first mortgage bonds of $650,000 par value 6 per cent debentures and $2,000,000 par value of common stock of the People's Gas Company. The company also asks permission to issue $15,000,000 5½ per cent 20 year first mortgage bonds and to sell $2,750,000 par value now; to issue also $2,000,000 of 6 per cent ten-year debentures, and $650,000 of that amount now; $2,000,000 par value common stock. The $15,000,000 bonds are to be secured by a trustee deed, and the $2,000,000 of securities by a second mortgage.

NEWS OF IDAHO PUBLIC UTILITIES COMMISSION

The commission has granted a certificate of convenience and necessity to the Electric Investment Company for an extension of its electrical transmission and distribution system from Meridian to Kuno, Ada county, Idaho.

EXAMINATION FOR VALUATION ANALYST.

The United States Civil Service Commission announces an open competitive examination for valuation analyst to fill several vacancies in the Division of Valuation, Interstate Commerce Commission, salaries in the first grade ranging from $3600 to $5000 per annum, and in the second grade from $1800 to $3300 per annum. The duties of this position will be to compile data and to prepare complete, concise and logical reports upon valuation subjects and to analyze, edit and digest reports submitted by sections of the Division of Valuation. Competitors will not be assembled for examination, but will be rated on education (30), experience (30), reports and writings submitted (40). Applicants for positions under grade 1 must show that they have had at least eighteen months' responsible, satisfactory experience in the final preparation of financial, statistical, or valuation reports upon public utilities. For grade 2 positions, such experience for at least six months must be shown. In each case this experience should have been gained in the employment of a public authority or commission engaged in the effectual regulation of public utilties, or with an important public utility, or in investigations of a similar character. Experience with mercantile concerns, with large utilities in routine positions, or with small utilities with limited operations will not be accepted as qualifying experience in this connection.

HEARING ON ENGINE SAFETY ORDERS.

The Industrial Accident Commission of California will hold a public hearing on engine safety orders at San Francisco on April 25th and at Los Angeles on May 9th. In 1914, there were in the State of California 15 deaths from accidents due to engine hazards, 99 permanent disablements and 1451 temporary disablements, giving a total of 1565. There were 23,138 days lost to injured workers as a result of the 1451 temporary disablements. The total cost of compensation and medical payments for the 1565 accidental injuries was $99,599.06. The following committees prepared the Engine Safety Orders:

San Francisco Committee on Engine Safety Orders: F. H. Varney (chairman), chief engineer operation and maintenance Pacific Gas & Electric Company, representing the users of engines; (F. W. Small, Pacific Gas & Electric Company, alternate to Mr. Varney); E. A. Selfridge, Jr., Northwestern Redwood Company, representing the lumber interests; W. H. Healy, president Healy-Tibbitts Construction Company; (J. N. Lohse, Healy-Tibbitts Construction Company, alternate to Mr. Healy; P. L. Ennor, representing the International Association of Steam and Operating Engineers, Local No. 64; (W. R. Towne, representing the International Association of Steam and Operating Engineers, Local No. 64, alternate to Mr. Ennor); J. T. Thorpe, representing the International Association of Machinists; R. L. Hemingway, safety engineer Industrial Accident Commission; John R. Brownell (secretary), superintendent of safety Industrial Accident Commission; (Mr. Varney died shortly after the engine safety orders were completed).

Los Angeles Committee on Engine Safety Orders: W. Lewis Bell (chairman), president Fulton Engine Works; George S. Graham, Fairbanks-Morse Company; David Brian, chief engineer Hotel Clark; George C. Flint, Los Angeles County Erecting Engineer; J. A. Young, chief engineer Western Gas Engine Company; Henry Wiatt, superintendent Electric Manufacturing, Los Angeles Gas & Electric Corporation; Ernest Cowelson, representing Machinists' International Union No. 311; H. L. Boyd (secretary) safety engineer Industrial Accident Commission.

NEW CATALOGUES.

Bulletin No. 202-I from Standard Underground Cable Company details Colonial Copper Clad Wire as to uses, methods of manufacture, specifications and comparative properties.

The Usona Manufacturing Company of San Francisco have issued a neat booklet illustrating and describing "Kwik-lite" battery flashlights, hand lights and batteries.

Booklet No. 51 from Hurley Machine Company, is being distributed by the Pacific States Electric Company. The complete line of Thor washing machines, ironing machines and vacuum cleaners are illustrated and described.

Electrical Blue Book, seventh edition; Electrical Review Publishing Company, Chicago; list of approved construction material and fittings, national electrical code, illustrated; A. I. E. E. code of professional conduct, street lighting schedules, etc.

An attractively illustrated art circular has just been issued jointly by the Pelton Water Wheel Company of San Francisco-New York, and the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa., describing the Pelton-Westinghouse water wheel generator sets and their applications.

DOMESTIC ELECTRIC RANGES.

Herewith is presented a tabulated list of specifications of various makes of electric ranges. Data have been given only for those manufacturers or sales representatives who have been reached during the limited time available for this compilation. Further details will be given subsequently.

In general, it may be stated that all these makes of electric ranges have much the same appearance as a gas range, thus introducing no confusing feature to the housewife. Burners are capable of giving three heats—high, medium and low—by means of indicating snap switch. Ovens are generally equipped with thermometers and lined with some insulating material so as to cook with retained heat and thus greatly reduce current consumption. Two oven heating elements are employed, one on the bottom and one on top, this also being used for broiling.

General Electric Company

No.	Type.	Oven Wattage.	Number and Wattage Service Burners.	Total Wattage.	Oven Dimensions.	Oven Insulation.	Finish of Range.	Type of Heating Unit.	Shipping Weight.
R 1	Oven low	1000 1000	2-1000 3-2000	4600 w.	18x18x12	Colorox	Coach Body	Sheathed wire, cut in	355 lbs.
R 2	Oven above	1000 1000	2-1000 3-2000	4600 w.	18x18x12	"	"	"	500 lbs.
R 3	Oven side	1000 1000 1-warmer 200 w.	2-1000 3-2000	4800 w.	18x18x12	"	"	"	670 lbs.
R 4	Oven side	1000 1000	2-1000 3-2000	4600 w.	18x18x12	"	"	"	389 lbs.
S 1	Oven low	1500 Broiler 1000	3-1000	5500 w.	18x18x12	1½" air-cell Asbestos	Black Japan	"	222½ lbs.
S 2	Oven above	1500	3-1000	5500 w.	18x18x12	"	"	"	250 lbs.
S 3	Oven side	1500	3-1000 1-2000	5700 w.	18x18x12	"	Black Japan and White Enamel	"	385 lbs.

Globe Stove & Range Company.

No.	Type.	Burner Wattage.	Oven Wattage.	Total Wattage.	Oven Dimension.	Oven Insul.	Finish.	Heating Units.	Shipping Weight.
A 2	2 low ovens	1-1500 1-1100 2- 880	1-1500 3-1000	8860	19x20x13 12x12x13	"Kiesel guhr."	Nickel or white porcelain enamel steel	Open type chromed wire backed with asbestos lava and covered with metal wearing plate	
E 2	1 side oven	1-1500 1-1100 2- 880 1- 330	1-1500 1-1000	7190	13½x13½x19 "	"			
B 3	1 low oven	1-1500 1-1100 1- 800	1-1500 1-1000	5900	"				
B-4	1 side oven	1-1500 1-1100 1- 330	1-1500 1-1000	5090	"				
B 5	1 high oven	1-1500 1-1100 1- 880 1- 330	1-1500 1-1000	6310	"				

Hot Point Electric Company.

No.	Type.	Burner Wattage.	Oven Wattage.	Total Wattage	Oven Dimension.	Oven Insul.	Finish.	Heating Units.	Shipping Weight
D	1 side oven	1-1500 1-1200 2- 800	2-1200	6700	18½x18½x12 18½x18x10	Mineral wool	Black Enamel	Glowing coil reflector	275
E	1 side oven	1-1500 1-1200 1- 800	2-1000	5500	16½x16½			supported by steel	240
F	1 high oven	1-1500 1-1200 1- 800	2-1000	5500	"			truss and porcelain	195
G	1 high oven	1-1500 1-1200 1- 800	2-1000	5500	"			frame	195
H	1 low oven	1-1500 1-1000	2-1000	4500	"				140

Western Electric Company.

No.	Oven Position.	Top Burners.	Surface Wattage.	Oven Wattage.	Total Wattage.	Oven Insul.	Oven Dimensions.	Heating Units.	Shipping Weight.
C-2	Side	2	2600	1760	4360	Rock Wool	18x12x12"	Open	240 lbs.
C-3	Side	3	3480	1760	5240		18x12x12"		260 lbs.
C-4	Side	3	3480	2200	5680		18x18x12"		275 lbs.
C-17	Above	2	2000	None	2000		18x11x8"		90 lbs.
C-18	Low	2	2600	1760	4360		18x12x12"		150 lbs.
27	Low	2	2600	1760	4360		18x12x12"		150 lbs.
30	Low	3	3480	1760	5240		18x12x12"		150 lbs.
33	Above	3	3480	1760	5240		18x12x12"		250 lbs.
37	Low	3	3480	2200	5680		18x18x12"		175 lbs.
40	Low	4	4360	2200	6560		18x18x12"		185 lbs.
44	Above	4	4360	2200	6560		18x16x12"		270 lbs.
47	Side	3	3480	2200	5680		18x18x12"		350 lbs.
48	Below	6	6340	2200	8540		18x18x12"		225 lbs.
50	Side	4	4360	2200	6560		18x18x12"		335 lbs.
56	Side	4	4360	4000	8360		18x18x12"		430 lbs.
60	Side	6	6340	4000	10340		18x18x12"		500 lbs.

Westinghouse Electric & Manufacturing Co. Automatic and Non-Automatic.

No.	Type.	Burner Wattage.	Oven Wattage.	Total Wattage.	Oven Dimensions.	Oven Insul.	Finish.	Heating Unit.	Shipping Weight.
3-19	Side oven	1-2000 2-1000	2000 850	6850	18½x13½x16 10⅝x13½x11½	Rock Wool	Nickel or Japan	Radiant Open Coil	400
2-19	Low oven	1-2000 2-1000	2000	6000	18½x13½x16				295
406	Low oven	2-1000	1660	3600	16½x12x11½				90

Rathbone, Sard & Company.

No.	Type.	Burner Wattage.	Oven Wattage.	Total Wattage.	Oven Dimension.	Oven Insul.	Finish.	Heating Units.	Shipping Weight.
E 5	Low oven	4 unith	2 units	5500		Duro therm.	Plain	Sheathed	
E 20	High oven	4 units	2 units	7000	1 separate	Duro therm.	Plain	wire	
E 30	High oven	4 units	2 units	7000	broiler unit.	Duro therm.	Plain		

Rutenber—Non-Automatic

105	Low oven	4 units 1000 w.	2 units 1000 w.	6000	18x18x14	Rock wool	Plain or nickel	Radiant spiral	240
110	Low oven	3 units 1000 w.	2 units 800 w.	4600	18x12x14	Rock wool	Plain or nickel	units	210
115	Low oven	2 units 1000 w.	2 units 800 w.	3600	18x12x14	Rock wool	Plain or nickel	in grounded porcelain supported by pressed steel container	203
120	No oven	2 units 1000 w. 2000							50
125	No oven	3 units 1000 w. 3000							55

Simplex Electric Heating Company.

No.	Type.	Burner Wattage	Oven Wattage.	Total Wattage.	Oven Dimension.	Oven Insul.	Heating Unit.	Shipping Weight.	Finish.
4 K	Oven low	2- 735 1- 440	1300	3210	15x12x11½	Mineral wool	Sealed in discs	200	Black Japan
5 K	Oven low	1-1300B 1- 735 1- 440	1300	2475	15x12x11½		Lock-on utensils	225	
6 K	Oven low	1-1300B 1- 735 2- 440	1600	4515	15x18x11½			243	
7 K	Oven low	1-1300B 2- 735 1- 440	1600	4810	15x18x11½			245	
8 K	Oven low	1-1300B 2- 735 2- 440	1600	5250	15x18x11½			250	
9 K	Oven low	1-1300B 1-1600 2- 735 1- 440	1600	5910	15x18x11½			295	
14 K	Oven low	1-2200B 1-1300 1-1100 1- 735 1- 440	2400	8175	21½x19x13			425	
21 K	Oven side	1-1300 1- 735 2- 440	1600 200	4715	15x18x11½			350	
22 K	Oven side	1-1300B 2- 735 2- 440	1600 200	5010	15x18x11½			350	
23 K	Oven side	1-1300B 2- 735 1- 440	1600 200	5450	15x18x11½			350	
24 K	Oven side	1-1300B 1-1100 2- 735 2- 440	1600 200	6110	15x18x11½			390	
31 K	Oven side	1-1300B 1- 735 2- 440	1600	4515	15x18x11½			325	
32 K	Oven side	1-1300B 2- 735 1- 440	1600	4810	15x18x11½			325	
33 K	Oven side	1-1300B 2- 735 2- 440	1600	5250	15x18x11½			325	
34 K	Oven side	1-1300B 1-1100 2- 735 2- 440	1600	5910	15x18x11½			365	

TRADE NOTES.

The Reliable Electric Company has finished the wiring and electric fixtures for the new Elite Market on Sacramento street, San Francisco.

Samuel A. Sizer, a large real estate and timber owner, of Portland, has joined the Ne Page, McKenny Company, electrical engineers and contractors of this city, as secretary and treasure.

Arrangements are being perfected to form a baseball league among the employees of the San Francisco electrical jobbers. A game was played between the Westinghouse Electric & Manufacturing Company and the Electric Railway & Manufacturers' Supply Company on April 13, the former winning by a score of 12-3. The first ball was thrown by Samuel Taylor and caught by R. F. Behan.

The Interstate Electric Novelty Company has now moved to its new factory at 104 South Fourth street, Brooklyn. The flashlight industry has expanded so rapidly within the past few years that their former factory was not large enough to fill the demand for Franco products. The new factory which is seven stories high, containing nearly 100,000 square feet of floor space, is equipped with the latest and most up-to-date machinery devoted entirely to the manufacture of Franco material.

One of the prominent electrical contractors said the other day: "I'm not getting any contracts lately. It's worse with me than it has ever been. Now, here, for example, is a specification sheet with figures for the different parts of the job, showing the actual cost of wiring detail with just a small margin of profit added and yet I am $700 too high over the lowest bid. It has been that way more lately than it has been in the past. What's the reason?" I buy my stock just as close as any of them; I discount my bills. I don't pay any more for labor. I watch the job myself to see that there is no waste of material, no time lost, and I flatter myself I can put the job through as quickly and economically, if not quicker, than any other, because being at least thirty years in the business I ought to know how, and yet I figure $2500 on the job, then actually cut out nearly all of my profits by reducing it to $2225, and still some one figures $700 lower Is it any wonder the electrical contracting business is shot to pieces?

NEWS NOTES

INCORPORATIONS.

SAN FRANCISCO, CAL.—The Electric Sales Service has been incorporated with a capital stock of $100,000, by W. W. Briggs, H. E. Kennedy, H. A. Mulvay, W. S. Leffler and W. S. Braun.

SANTA BARBARA, CAL.—The Santa Barbara Telephone Company has been incorporated with a capital stock of $700,000, by R. E. Easton, E. A. Gilbert, G. B. Bush, A. Edwards and F. L. Rabe, to take over the Sunset and Home telephone systems in this city.

SAN BERNARDINO, CAL.—The Fontana Power Company has been organized here with a capital of $350,000. The incorporators are A. B. Miller, J. C. Jones, R. H. Bassler, C. A. Stone, A. M. Wilson, all of Fontana, with the exception of Mr. Jones, who resided at Etiwanda. It is understood that company will develop water power in the mountains.

ILLUMINATION.

NOME, ALASKA.—At a recent election it was voted to issue bonds for the installation of a municipal lighting plant.

ALAMOGORDO, N. M.—The Alamogordo Light & Power Company's plant has been sold to the town of Alamogordo for $25,000.

PT. ANGELES, WASH.—The contract for electric meters has been awarded by the city lighting department to the General Electric Company.

SAN PEDRO, CAL.—Petitions are being signed for the installation of ornamental street lights on Sixth street between Beacon and Pacific avenue.

LOS ANGELES, CAL.—The city council has granted a petition for the ornamental lighting of Hollywood Boulevard between Cherokee avenue and Wilcox avenue.

LOS ANGELES, CAL.—The board of supervisors has awarded a contract for street lights in the Sherman Lighting District to the Southern California Edison Company.

SOUTH SAN FRANCISCO, CAL.—The city trustees have entered into a contract with the Pacific Gas & Electric Company to install a new electric lighting system for this city.

VENTURA, CAL.—The Ventura County Power Company has applied for a franchise to extend its light and power lines along Ventura avenue and other parts of the county.

SANTA ANA, CAL.—The Southern Counties Gas Company has applied to the board of supervisors for a franchise to lay gas lines in all the beach towns which are now without a gas supply.

WESTLAKE, ORE.—Captain W. G. Campbell has left for Portland to see about arrangements for fluming the water power recently located between here and Clear Lake. Later, equipment will be put in to develop electric power.

PASADENA, CAL.—A resolution of intention has been adopted by the city council for the construction of a lighting system on Green street, and the issuance of bonds to cover the cost of the improvement.

BAKER, ORE—Members of the merchants' committee of the Commercial Club called on the business men relative to the proposal of the city commissioners that the business men and property owners lend financial assistance in putting in cluster lights.

FLORENCE, CAL.—The town council has passed an emergency ordinance creating a light and water commission to handle all business in connection with the installation of a water and light system. J. G. Keating, Ramon Arballo and J. W. McCann are the members of the commission.

OAKLAND, CAL.—Elaborate plans for lighting Lincoln Highway beyond the city limits with electric lights were launched by Commissioner Jacosn, who introduced a resolution authorizing Carl E. Hardy to submit to the Council an estimate of the cost of installation and upkeep of the proposed system.

LOS ANGELES, CAL.—The city council has passed ordinances declaring intention to order the necessary appliances installed and electric current furnished for one year for lighting Figueroa street between Sixth and Tenth streets, Main street between Pico and Thirty-sixth Place, Arlington avenue between Pico and Country Club Drive and certain other streets.

PORTLAND, ORE.—Details for providing Portland with a municipal power house and lighting system from which it will derive 4000 horsepower of electric energy, are being worked out by the engineers of the public utilities department. The plans call for the erection of a hydroelectric generating plant on the Bull Run river in connection with an impounding dam, which soon will be necessary for the conservation of the city's water supply. The question of a bond issue for constructing the plant will be submitted to the voters.

TRANSMISSION.

WALLACE, CAL.—The city council has granted a right of way through the city to the Washington Power Company, which is preparing to construct power lines up Placer creek to the mines.

RIVERSIDE, CAL.—A new power company which proposes to build a transmission line from Temecula, through Fallbrook, Oceanside and Escondido, has filed application with the supervisors for a franchise extending from Elsinore to the San Diego county line, via Wildemar, Temecula and Murietta. Connection will be made with the Southern Pacific Company's line at Elsinore.

TRANSPORTATION.

COLTON, CAL.—An ordinance granting permission to the Pacific Electric Railway Company to construct single track railway connection at Ninth and J streets has been passed.

OAKLAND, CAL.—The city Council has adopted a resolution by which the San Francisco-Oakland Terminal Railways obtains the privilege, without obtaining a franchise, of establishing some kind of street car service between Broadway and Webster street.

TELEPHONE AND TELEGRAPH.

WENATCHEE, WASH.—A franchise for a telephone line in the Chelan forest has been granted to Forest Supervisor Milham.

FT. BAYARD, N. M.—Orders have been issued for the establishment of an underground telephone system here. Engineer W. S. MacDonald has been assigned to do the work.

FILLMORE, CAL.—It has been announced by the Pacific Telephone Company's Los Angeles offices that a thoroughly modern telephone system will be installed here in June or July, if not sooner.

COEUR d'ALENE, IDAHO.—A delegation of farmers north of the city appeared before the Chamber of Commerce asking for a telephone line. The chamber referred the application to a committee consisting of Dr. J. W. Scott, H. H. Tuft and H. A. Sampson.

NOGALES, ARIZ.—The La Usa Telephone Company has made application to the supervisors of Santa Cruz county for a franchise to construct telegraph and telephone lines from Amadoville to the county line and from the county line south of Arivaca to Oro Blanco and Jarillito, respectvely.

ALPHABETICAL INDEX TO ADVERTISERS

The letter and number before each name are used in the classified page following

A-1 **American Ever-Ready Works of National Carbon Co.**
Los Angeles; 755 Folsom St., San Francisco; Seattle.

A-2 **Atchison, Topeka & Santa Fe Railway Co.** 10
673 Market St., San Francisco; 1218 Broadway, Oakland.

B-1 **Baker-Joslyn Company** 10
71 New Montgomery St., San Francisco; 911 Western Ave., Seattle; 353 E. Second St., Los Angeles.

B-2 **Benjamin Electric Manufacturing Co.** .....
590 Howard St., San Francisco.

B-5 **Bridgeport Brass Co.** 10
(See Pierson, Roeding & Co.)

C-1 **Century Electric Co.** 4
906 So. Hope St., Los Angeles; 56 Natoma St., San Francisco; 65 Front St., Portland, Ore.

C-3 **Crocker-Wheeler Co.** .....
Crossley Bldg., 618 Mission St., San Francisco; 228 Central Avenue, Los Angeles.

C-4 **Cutler-Hammer Manufacturing Co.** .....
579 Howard St., San Francisco; Morgan Bldg., Portland, Ore.; San Fernando Bldg., Los Angeles.

D-4 **Davis Slate & Manufacturing Co.** 3
Chicago, Ill.

D-2 **Dearborn Drug and Chemical Works** 9
355 East Second St., Los Angeles; 301 Front St., San Francisco.

E-1 **Edison Lamp Works of General Electric Co.** .....
Rialto Bldg., San Francisco; 724 So. Spring St., Los Angeles.

E-2 **Edison Storage Battery Supply Co.** 9
441 Golden Gate Ave., San Francisco.

E-3 **Electric Agencies Co.** .....
247 Minna Street, San Francisco; Central Building, Los Angeles.

E-6 **Electric Novelty Works** .....
533 Mission St., San Francisco.

E-4 **Electric Storage Battery Co.** .....
743 Rialto Bldg., San Francisco.

E-5 **Electric, Railway & Manufacturing Supply Co.** 9
34 Second St., San Francisco.

F-1 **Fairbanks, Morse & Co.** .....
Los Angeles; Portland; 651 Mission St., San Francisco; Seattle; Spokane.

F-3 **Federal Sign System (Electric)** 5
618 Mission St., San Francisco.

G-1 **General Electric Co.** 10
724 So. Spring St., Los Angeles; Worcester Bldg., Portland; Rialto Bldg., San Francisco; Colman Bldg., Seattle; Paulsen Bldg., Spokane.

G-1 **General Vehicle Co.** .....
1117 Van Ness Ave., San Francisco; 331 Wall St., Los Angeles; British Columbia Electric Ry., Ltd., Vancouver, B. C.

H-1 **Habirshaw Wire Co.** .....
(See Western Electric Company.)

H-2 **Hemingray Glass Co.** 9
330 So. Los Angeles St., Los Angeles; 345 Oak St., Portland; 807 Mission St., San Francisco.

H-5 **Hunt, Mirk & Co.** .....
141 Second St., San Francisco.

H-7 **Hurley Machine Co.** 2
New York and Chicago.

I-2 **Illinois Electric Co.** .....
261-263 So. Los Angeles St., Los Angeles.

I-3 **Interstate Electric Novelty Co.** 3
111 New Montgomery St., San Francisco.

L-1 **Leahy Manufacturing Co.** .....
Eighth and Alameda St., Los Angeles.

L-2 **Locke Insulator Manufacturing Co.** 10
(See Pierson, Roeding & Co.)

M-2 **McGlauflin Manufacturing Co.** .....
Sunnyvale, Cal.

M-4 **Morse Chain Co.** .....
Monadnock Bldg., San Francisco.

M-3 **Moore & Co., Charles C.** 3
Van Nuys Bldg., Los Angeles; Spalding Bldg., Portland; Kearns Bldg., Salt Lake City; Sheldon Bldg., San Francisco; Mutual Life Bldg., Seattle; Santa Rita Hotel Bldg., Tucson.

N-1 **Nason & Co., R. N.** .....
151 Potrero Ave., San Francisco.

N-6 **National Carbon Company** 4
Cleveland, Ohio.

N-2 **National Conduit & Cable Co., The** .....
Trust and Savings Bldg., Los Angeles; Rialto Bldg., San Francisco.

N-3 **National Lamp Works of G. E. Co.** .....
(All Jobbers.)

N-4 **New York Insulated Wire Co.** .....
629 Howard St., San Francisco.

N-5 **Northwestern Pacific Railroad** .....
808 Phelan Bldg., San Francisco.

O-1 **Okonite Co. (The)** 10
(All Jobbers.)

P-1 **Pacific Electric Manufacturing Co.** .....
80 Tehama St., San Francisco.

P-2 **Pacific States Electric Co.** 2
236-240 So. Los Angeles St., Los Angeles; 90 Seventh St., Portland; 200-210 Twelfth St., Oakland; 575 Mission St., San Francisco; 307 First Ave. So., Seattle.

P-4 **Pelton Water Wheel Co.** 9
2219 Harrison St., San Francisco.

P-5 **Pierson, Roeding & Co.** 10
Pacific Electric Bldg., Los Angeles; Rialto Bldg., San Francisco; Colman Bldg., Seattle.

P-7 **Pittsburgh Piping & Equipment Co.** 10
Monadnock Bldg., San Francisco.

S-1 **Schaw-Batcher Company, Pipe Works, The** .....
211 J St., Sacramento; 356 Market St., San Francisco.

S-4 **Southern Pacific Co.** 4
Flood Bldg., San Francisco.

S-5 **Sprague Electric Works** 3
Rialto Bldg., San Francisco; Colman Bldg., Seattle; Corporation Bldg., Los Angeles; Electric Bldg., Portland; Paulsen Bldg., Spokane.

S-6 **Standard Underground Cable Co.** .....
First National Bank Bldg., San Francisco; Hibernian Bldg., Los Angeles; Yeon Bldg., Portland; Central Bldg., Seattle, Wash.

T-1 **Thomas & Co., R.** .....
Pacific States Electric Co. and Western Electric Co., Pacific Coast Representatives.

T-2 **Tubular Woven Fabric Company** .....
Pawtucket, R I.

W-1 **Wagner Electric Manufacturing Company** 3
St. Louis, Mo.

W-2 **Western Electric Co.** 4
Eighth and Santee Sts., Los Angeles; 1901 Telegraph Ave., Oakland, Cal.; 680 Folsom St., San Francisco; 907 First Ave., Seattle; 45 North Fifth St., Portland, Ore.

W-4 **Westinghouse Electric and Manufacturing Co.** 6
50-52 East Broadway, Butte; Van Nuys Bldg., Los Angeles; Couch Bldg., Portland; 212 So. W. Temple, Salt Lake City; 165 Second St., San Francisco; Second and Cherry Sts., Seattle; Paulsen Bldg., Spokane.

W-5 **Westinghouse Machine Co.** .....
141 Second St., San Francisco.

W-6 **Westinghouse Lamp Co.** .....
(See Westinghouse Electric & Manufacturing Co.)

W-8 **Western Pipe & Steel Co.** .....
444 Market St., San Francisco; 1758 North Broadway, Los Angeles.